SCIENTIFIC AMERICAN

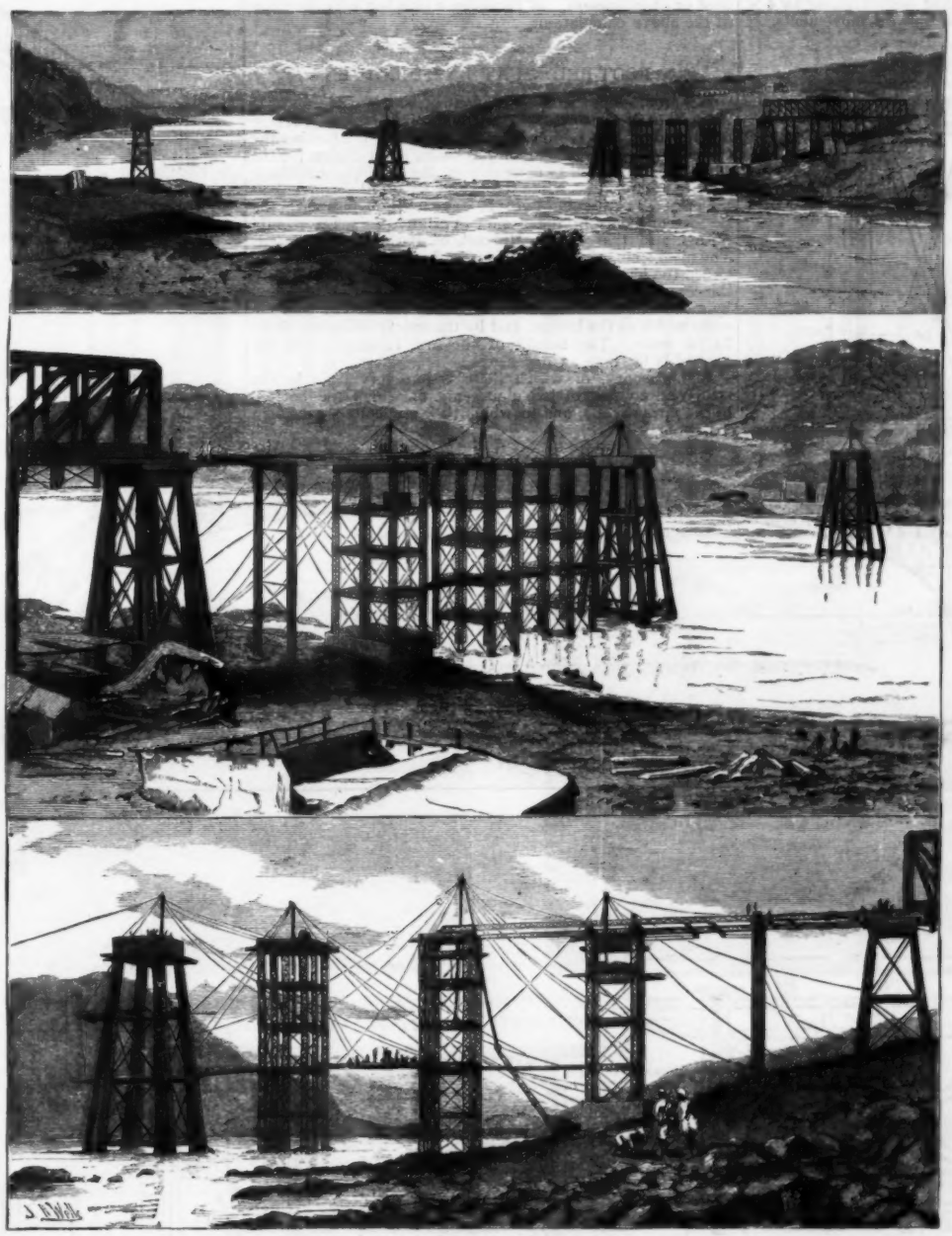
No. SUPPLEMENT 381

Scientific American Supplement, Vol. XV., No. 381. Scientific American, established 1845. | NEW YORK, APRIL 21, 1883. | Scientific American Supplement, $5 a year. Scientific American and Supplement, $7 a year.

THE INDUS RAILWAY BRIDGE.

THIS important work, constructed during the past year under the superintendence of Mr. O'Callaghan, engineer-in-chief, with able assistants, will be completed in June. Among the remarkable works of the kind which British skill and science have erected in India, the Attock Bridge will stand second to none. It will consist of five spans—two of 308 ft. each, and three of 257 ft. each. The whole structure will be of iron. The iron work for the spans was made by Messrs. Westwood, Baillie & Co., of London, and that for the piers by Messrs. Handyside & Co., of Derby, from the designs of Mr. A. M. Rendel, C.E. The third pier, which stands in the middle of the river, exposed to all the violence of the floods, will be protected by a massive cut-water, of best masonry, about 100 ft. high. It has been proposed to protect all the piers by cut-waters, as recent floods have proved that the second and fourth piers require protection. Last July saw the Indus in the highest flood known for several years; and the center pier, though as yet unprotected by a cut-water, stood the test very well—only one of its diagonal vertical pieces being slightly injured. The iron work of the first two spans is completed, and the staging for the third and fifth spans is progressing favorably. At the latest, another year ought to see the railway running without a break from Lahore to Peshawur.

The site of the bridge is about two miles below where the Grand Trunk road now crosses the river, which crossing place is under the walls of the old Sikh fort of Attock. The view represented in our illustration was taken at the end of January, just one year from the date of commencing the erection of the iron work. The river is here shown at its very lowest; but, during the floods, it extends from one abutment to the other, and has been known to rise to within 15 ft. of the level of the bottom of the girders—100 ft. above its lowest level. On July 29, last year, it rose to the height of 65 ft. 7 in., as recorded by an inscription on pieces of iron lately attached to the first and last pier. The river Indus was always considered as the boundary of Hindoostan; and, as the name of Attock implies, a barrier beyond which no Hindoo could pass. When the British Government took possession of the Peshawur Valley, at the close of the second Sikh war, they needed means of communication; accordingly the Grand Trunk road, which already extended from Calcutta to Lahore, was continued to Peshawur; communication across the Indus being kept up by a boat bridge in the dry season, and by a ferry during the rains. It was at one time proposed to carry the road under the bed of the river by means of a tunnel, and the heading, or driftway, under the river was actually completed; but the great expense of the approaches, which necessitated nearly three miles of tunnel, caused the Government of India to abandon the idea. As railways in India extended, it was felt that communication with the frontier, by some more expeditious method than an ordinary road, was required; and in 1869 the construction of the Punjaub Northern Railway was sanctioned. Various circumstances prevented the construction of this line beyond Jhelum, till the last Afghan War was begun, in 1879; after which the government determined to extend the railway to Peshawur. The line is now complete, with the exception of this bridge over the Indus; and our illustration, from a photograph by Mr. J. Burke, of Rawul Pindi, shows the progress which has been made with its construction.—*Illustrated London News.*



THE ATTOCK RAILWAY BRIDGE OVER THE INDUS.—VIEWS SHOWING THE PROGRESS OF ITS CONSTRUCTION.

THE new ship canal between the Baltic and the North Sea will save nearly 600 miles of the water journey now made around the Danish peninsula. The cut, as proposed, will be from Gluckstadt to Kiel, and the length will be about half that of the Suez Canal, or some 50 miles.

VIBRATIONS IN BRIDGES.

PROF. S. W. ROBINSON in a report included in the forthcoming report of the Ohio Railroad Commissioners submits the following very interesting remarks on cumulative vibrations in bridges:

It is a well known physical fact that rhythmical impulses, though very slight individually, will result in an astonishing cumulative action when applied for a time to a body so circumstanced as to vibrate in equal rhythm. Soldiers in marching must break step in passing over foot bridges, else, if the bridge should have a time of vibration equal to the time of step, the structure would vibrate seriously. The trot of a dog has been observed to cause a street bridge to vibrate with decided intensity, the vibration being observed to keep time with the dog. Horses in vehicles "must not move over the bridge faster than a walk," for fear the trot and vibration periods shall agree. The child in a swing is able to rise from a low to a high altitude without help, simply by a tilting motion of the body, so directed that each adds a slight impulse to the oscillatory movement. Similarly, in railroad bridges a slight want of perfect balance of the locomotive driving wheels may cause unexpected vibrations and unanticipated strains when the times of half revolution of drivers harmonize with the bridge vibration time. The likelihood of such synchronism may be rendered more apparent by means of calculated results. For example, a train moving at the rate of 30 miles per hour has a velocity of 44 ft. per second. Locomotive drivers of 5½ ft. diameter make one revolution in about 0·4 second, or a half revolution in 0·2 second.

Now, an iron bridge of 150 ft. span will weigh about 1,400 lb. per foot. In vibrating vertically, as by placing a heavy load upon it suddenly, the ends at abutment do not participate, while the middle is most active. To get an approximation, without going into refinements as to distributed masses, suppose half the bridge length to vibrate equally while the quarters near the abutments do not vibrate, then half the weight of the bridge will enter into account for vibration, or 105,000 lb. Next, let us suppose a train moves rapidly on in which the drivers are out of balance; if the bridge vibrates, the engine and train to abutment, will vibrate with it, so that a portion of vibratory mass must be added. Taking the weight of the train at 2,000 lb. per foot, the half span, or 75 ft., will weigh 150,000 lb. Finally, let it be supposed that the static deflection of the bridge for this train load is 1 in., which is about that found for such cases. Now, by the principles of dynamics the time of vibration for this case, supposing the load at the center of bridge, is found to be—

$$t = \pi \sqrt{\frac{Wd}{wg}}.$$

Where W is the total load, 105,000 + 150,000 = 255,000 lb., w the added load = 150,000 lb., d = the static deflection = 1 in., or $\frac{1}{12}$ ft., and g = the acceleration of gravity = 32, nearly. Introducing these and reducing, we find the time of a simple vibration to be 0·2 second, a value which agrees with the time of revolution of the drive wheels. Hence unbalanced drivers will here cause vibration, with a period of 0·2 second. The period from the highest point back to that point of movement will correspond to the entire revolution, or 0·4 second of time. This will cause 2½ complete movements per second, and is the period which would be noticed by an observer.

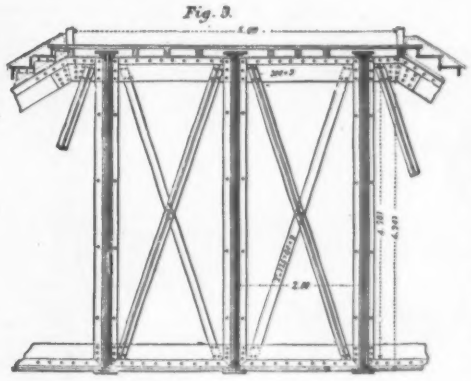
Similarly, a bridge of 300 ft. span weighing 2,000 lb. per foot, undergoing a static deflection of 2 in. from a freight train load of 2,000 lb. per foot, will vibrate in a period of 0·35 second. A double vibration, which corresponds with the time of revolution of a drive wheel, would be made in 0·7 second. This time of revolution of 4 ft. drivers answers to a train speed of about 11¼ miles per hour or 14½ for 5 ft. drivers. This case answers fairly to freight trains. Hence, it appears that bridges are liable to become badly shaken from cumulative impulses, those of 100 to 200 ft. span by passenger trains and those of 200 to 400 ft. span by freight trains. To estimate the amount of intensity of this action, first consider passenger trains. To this end we will take advantage of the calculations of Mr. J. W. Cloud, of Altoona, Pa., Engineer of Tests for the Pennsylvania Railroad. The results of his calculations are given in a valuable paper, evidently prepared with much care, on "Shocks on Railway Bridges," and read before the American Institute of Mining Engineers, February, 1881. His calculations are for a locomotive of the Pennsylvania Railroad, Class B, the weight of which in running order is 73,100 lb. Drive wheels, four in all, are 62 in. in diameter; weight of tender, loaded, 49,800 lb.

The shocks that Mr. Cloud calculates are those due to the centrifugal force of the counterbalance weights in the drive wheels, and considered as acting upon the bridge like a hammer with repeated blows, but without supposing synchronous bridge vibration to follow. These calculations, as far as the downward and upward thrusts from centrifugal force are concerned, are exactly to our purpose. At a speed of 50 miles per hour, these thrusts for each of the four wheels are given at 6,260 lb., and act downward when the counterweight is down, and upward when the counterweight is up, the two being repeated 4¼ times every second. For our present purpose we must find the effect of all the wheels on the bridge, supposing the latter to vibrate in synchronism.

Now, as the wheel revolves, the centrifugal force acts in the direction of a radius through the counterweight, but this radius revolves with the wheel. For a half revolution there is a component downward, and for the other half there is a

component upward. The resultant effect for a half revolution is about the same as though two-thirds of the force acted constantly for the half revolution downward, and then for a half revolution upward. Hence, for a single wheel two-thirds of 6,260 is 4,173 pounds. Now, to include the effect of the four wheels, it appears, from the fact that opposite wheels have cranks at right angles, the resultant of forces in a right angled triangle should be taken for each pair of wheels, giving $1{\cdot}42 \times 4{\cdot}173 \times 2$ pounds $= 11{,}851$ pounds for the combined action of all the wheels, in the form of a constant force for a half revolution. This is equivalent in its effect upon the bridge to that of all the counterweights. Now, it is well known by the principle of dynamics that the dynamic deflection due to this force is twice the statical. The latter can be found by simple proportion, in a comparison of the 11,851 lb. with the train load of 150,000. If the latter produces a deflection of 1 in., the former will cause a statical deflection of 0·079 in., which will be downward for the downward force, and *vice versa*. Calling these points of static deflection neutral points, we have for cumulative synchronous vibration the first dynamic downward deflection, equal to $2 \times 0{\cdot}079 = 0{\cdot}158$ in., with the lower neutral point at the middle of the amplitude. Now, because the force is reversed, the return amplitude will be such that the upper neutral point divides it equally, from which it appears (by aid of a sketch) that the latter amplitude is three times the first. The next amplitude, downward, with lower neutral point central, will be such as to reach a point in descent which is below the first lowest point of deflection, by a distance which equals four times the statical deflection. Now, by the continuation of this action, the force being supposed to reverse with the motion, each succeeding point of descent will be lower by a fourfold statical deflection, or by $4 \times 0{\cdot}079 = 0{\cdot}316$ in. Similarly for the upward movements.

Fig. 3.



per square inch, would, from the additional cause now considered, be strained to 25,800 lb. per square inch, a strain which is fully up to the elastic limit, and hence such a bridge would be in imminent danger of destruction. The individual impulses will vary as the square of the velocity, or speed of the trains, so that, for about 35½ miles per hour, the superadded strains will be only half what they are found for the above case of 50 miles per hour. But one point to be noted is that during a run of 100 or 200 miles, at a stated speed of 30 miles per hour, an occasional speed of 50 may be reached, and this, likely enough, at the critical moment of crossing a bridge.

For freight trains at 15 miles per hour, with 4 ft. drivers, a single impulse is only about one-seventh that for 50 miles, as above. But as the bridges attacked are twice as long, and the number of impulses twice as great, the resultant effect is about one-third that for the 50 mile speed, and hence causes a 35 per cent. superadded strain. This action is believed to be a potent cause in the destruction of bridges, because the drive wheel system is never exactly balanced. But such vibration is not expected for every train nor every bridge. The reason well authenticated instances of its occurrence are not plenty is probably due to the fact that observing persons are not often in the position to detect it. Cannot the survivors of the St. Charles bridge disaster explain? At least one case occurred in the experience of the writer, causing personal alarm for the second and a half that the engine was apparently jumping along the bridge. It was during a ride in the cab of an engine, while seated and leaning out of the window; the bouncing was decided, and with no mistake, because the ride in this position was taken for the express purpose of seizing upon any peculiar incident or phenomenon. It furnishes a striking corroboration of the above calculations.

FOOT-BRIDGE AT LA VILLETTE.

WE reproduce from our contemporary *Les Nouvelles Annales de la Construction* the illustrations of a foot-bridge erected over the basin at La Villette, and connecting the two quays on each side of the basin. The design for the work was submitted to competition, the principal condition required being, that while the bridge should be convenient for passengers, it should not in any way interfere with the passage of boats in the basin. Various designs were submitted, and that of M. Moisant, of Paris, was accepted. The clear span of the bridge is 282 ft. 19 in., the width between the handrails is 16 ft. 5 in., and the clear headway in the center is 35 ft. 5½ in. Access to the platform is obtained by means of staircases at each end, in the axis of and the same width as the bridge, and by transverse staircases 8 ft. 2½ in. wide. The height of the first landing above the ground is 18 ft.

The masonry, of which there is but very little in the structure, consists of two abutments, on which the bottom of the girders rests, and to which they are bolted, as shown

Fig. 9.

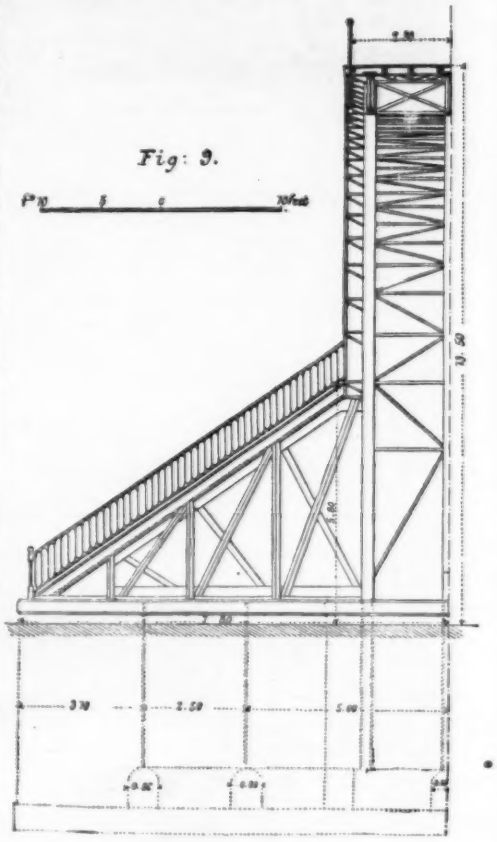


Fig. 1.

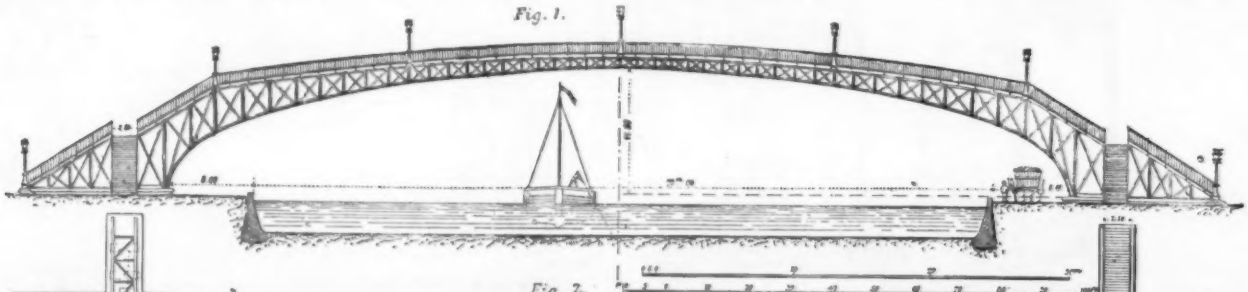


Fig. 2.

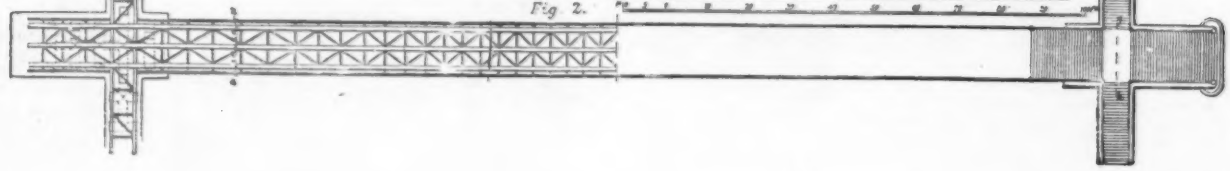


Fig. 4.

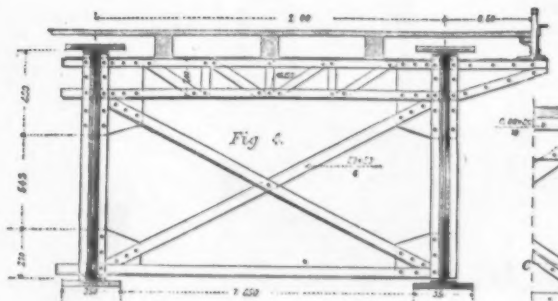


Fig. 5.

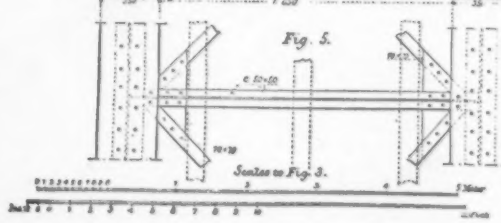


Fig. 6.

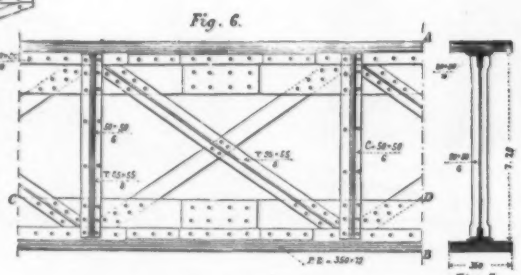


Fig. 7. Section at A B.

Fig. 8. Section at C D.

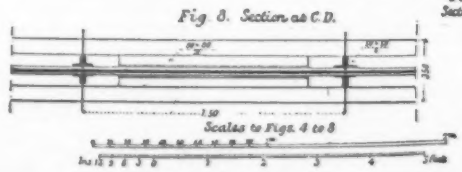


Fig. 10.

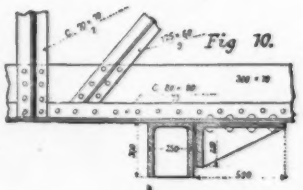
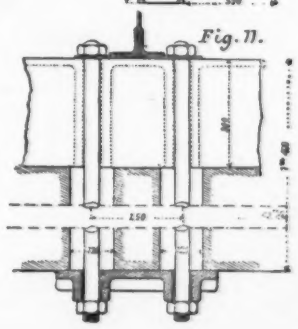


Fig. 11.



FOOT-BRIDGE OVER THE BASIN AT LA VILLETTE.

Now, as the wheel makes about five complete turns along the central part of the bridge, we find this fourfold deflection to be repeated five times, giving us a resultant total deflection, due to the cumulative action, of $5 \times 4 \times 0{\cdot}079 = 1{\cdot}580$ in., a deflection which is in excess of that due to the whole load of 150,000 lb., viz., 1 in., by over 50 per cent. Hence, the cumulative action more than doubles the strain on the bridge. From this it appears that an iron bridge, calculated for the usual statical strain of 10,000 lb.

in Fig. 3 and Fig. 11, represented above, galleries being left in the abutments for the purpose of adjusting the bolts. The superstructure consists of three girders having the general form shown in Fig. 1, above; they are placed 6 ft. 6·74 in. apart from center to center, and are 3 ft. 11 in. deep in the center between flanges. These latter are 13·78 in. wide and are formed of plates 0·39 in. thick, the webs are also 0·39 in. thick, and vary in depth according to their positions; they are connected to the flanges by angle irons

3·15 in. by 3·15 in. by 0·35 in. The space between the upper and lower flanges is filled in with panels, the vertical members of which are made of four angle irons, each 1·97 in. by 1·97 in. by 0·24 in.; the width of the panels varies with their position. These angle irons are riveted to the webs by rivets 0·55 in. in diameter; the rivets employed in fastening the webs to the flanges are 0·79 in. The intersecting diagonals between the verticals are made of T iron, varying in size from 3·74 in. by 2·17 in. by 0·31 in. in the panels at the middle of the bridge, to 5·90 in. by 3·15 in. by 0·35 in. in the bays nearest the abutments. Rivets 0·63 in. are employed for fastening them to the webs. The distance apart of the cross girders varies with that of the panels; they are fixed to the girders by means of vertical plate gussets 0·24 in. thick, and are made up of top and bottom members of angle iron 1·97 in. by 1·97 in. by 0·24

in., and diagonal connecting bars 1·58 in. by 0·24 in. (see Figs. 4 and 5). Outside the outer girders the roadway is extended by brackets, as shown. Upon these cross girders rest timber longitudinals 3·94 in. by 5·51 in., and 23·6 in. apart.

The planking, 1·3 in. thick, is secured to the longitudinals. The handrails are of wrought iron, and of the design shown. The total weight of the ironwork is about 150 tons. The following are the principal data from which the strains on the structure were calculated:

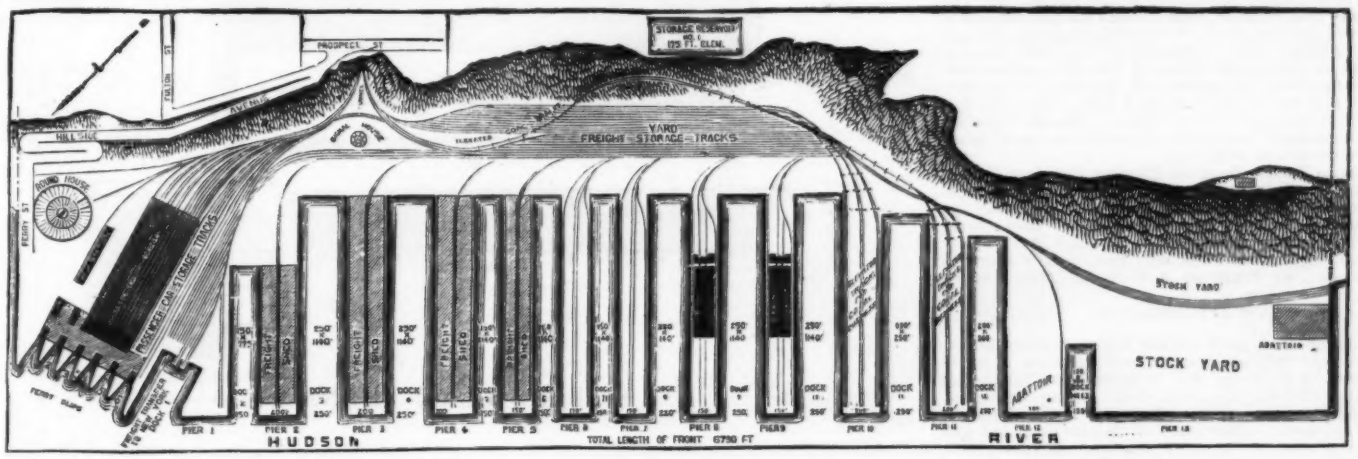
Strain on iron, tons per square inch.....	3·81	
Passing load on platform, per square foot.....	41	lb.
" " center girders " "	82	"
Weight of ironwork " " .....102·5		"
" " longitudinals and planking.....	20·5	"
Total load on middle girder, per sq. ft. lb.. ...208·0		

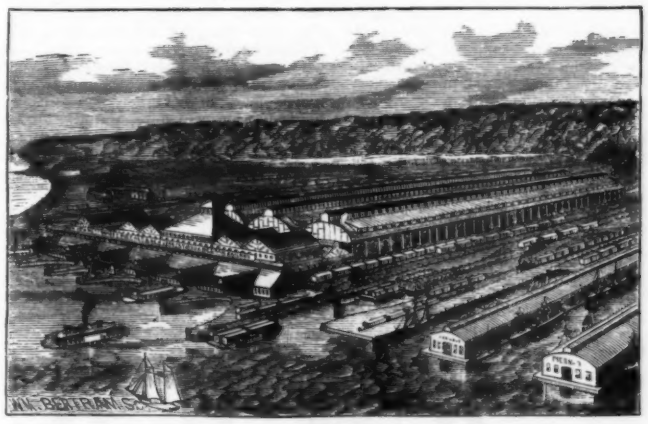
The vertical distance between the center of the arch and the point of rotation is 40 ft. 4·21 in., and the horizontal distance between the center of arch and the point of rotation, 151 ft. 2·1 in.—*Engineering.*

NEW YORK TERMINUS, N. Y., W. S. & B. R.

A LEADING feature of the New York, West Shore, and Buffalo Railway has been the completeness with which the work of construction has been done. No half measures are employed; it is more worthy the title of "Nickel Plate" than its new brother in the West. In the planning of its terminals at Buffalo and Weehawken the same broad ideas have been carried out by its projectors.

In the accompanying engraving we give a plan and views of the terminal arrangements at Weehawken, opposite New York city. The road to reach the river passes through the bluffs under Bergen Hill, and debouches on the plain intervening between the uplands and the river. The tunnel is a great engineering work, and is 3,985 feet long; the cuts leading to the tunnel aggregate 3,300 feet. The terminal has a water front of 6,790 feet, and contains an area of 440 acres, of which 200 acres between the foot of the bluff and the front line of the piers are available for piers, buildings, tracks, and other terminal requirements. The remaining 240 acres are on the bluff, and will be devoted to building lots for employes and others. Owing to its topography, no street can ever be extended over the part used for terminal purposes, which will, therefore, always be free from such interferences. Suitable ferries, piers, warehouses, station houses, and other facilities are provided, which will meet the wants of the road for many years, the piers being the largest ever built in the vicinity of New York city. The passenger facilities are large enough for all time. The freight facilities are ample for the next fifteen years, but the structures may then have to be increased. This can be readily done to any extent, as the unoccupied water-front in reserve is sufficient to meet any possible future demands. The northern end of the terminus is occupied by the stockyards formerly owned and used by the Erie, and purchased of them. They are complete and ready for use. There is sufficient track room at the terminus and its vicinity to store an unlimited number of cars.—*Railway Review.*





TERMINAL (OPPOSITE FORTY-SECOND STREET, NEW YORK) OF THE NEW YORK, WEST SHORE & BUFFALO AND THE NEW YORK, ONTARIO & WESTERN RAILWAYS.

THE SUEZ CANAL.—The revenue of the Suez Canal experienced a further very remarkable increase last year. The annexed figures show the transit revenue of the canal during the ten years ending with 1882 inclusive: 1873, £915,893; 1874, £994,375; 1875, £1,155,452; 1876, £1,199,000; 1877, £1,311,093; 1878, £1,243,929; 1879, £1,187,442; 1880, £1,592,419; 1881, £2,050,974; and 1882, £2,421,835. The check in the revenue in 1878 and 1879 was due to a reduction of duties, which appears, however, to have greatly stimulated business between British India and England.

GRAIN ELEVATORS.

THOSE whose business has led them hither and thither through the various great seaport and lakeport municipalities of the United States must often have cast a curious eye upward toward the elephantine grain elevators they saw towering above them, like Noah's ark, by every city waterside. What bustling, dusty, mysterious structures they seem to be! As to what is going on inside of them—how few know anything about it! People glance at them, beshrew them for their ugliness, have a vague feeling of comfort in the thought that the world can't starve as long as good sterling grain is flowing, like Pactolian rivers, along the railway and canals, and through the bins and shipping-pipes of these great grain-houses; and then they turn away and bestow no more thought upon them.

But that we shall not do. We propose to penetrate into all the mysteries and methods of this great business, and a round, unvarnished tale thereof deliver. Follow in your imagination a bushel of wheat, or Indian corn or rye, from the great golden grain fields of the world in Illinois, Nebraska, Kansas, or Dakota; accompany it on its long journey as it trundles over the glowing rail, or rushes through the yielding water; suppose it reaches the port of Boston to be shipped to some foreign port, say by a steamship of the Cunard or Allan line.

Now, an average freight car holds about twelve tons, or 500 bushels of grain. The car is run up along the side of the elevator building, and the grain is scooped out of each car by two men, who manipulate steam-power shovels, or scoops. Two men can thus empty a car in ten minutes, and can do the work of five men with hand-shovels only. The scoops have two handles and are operated by a rope and pulley; the man pulls the rope, which then begins to wind in, and by digging the scoop down into the grain it is easily shoved out of the car. From the car it is conducted by a "leg," or pipe, into huge bins or sunken pits, in the basement of the building; these are square boxes which taper up to a point, or apex, where the elevator chute, or "leg," connects with them. The next thing to do is to weigh the grain, and each car load is weighed separately.

HOW GRAIN IS ELEVATED.

The *modus operandi* is this: Understand that the grain has got to be elevated to a great height and stored, in order that gravity may act on it when it is desired to transfer it to a ship. (And this is the reason elevators are made so high.) Well, now, it costs money to carry anything in a different direction from that which Mr. Principle of Gravitation is traveling; he is a very stubborn old gentleman, and likes to have his own way. Hence, as we have got to weigh that wheat and store it away both, we might as well lift it at once to the top of the building and weigh it there, and then it will be where it is wanted to remain.

Accordingly we have a mighty power-belt of rubber canvas two feet broad. This belt stretches perpendicularly through the building, and runs over a pulley at the top. It runs the shafting, which in turn runs the half dozen or more endless traveling belts on which are set, about a foot apart, certain scoops, buckets, or grain-cups, made of thick tin bound with hoop-iron, and holding about a peck each. These revolving buckets pass through a leg or chimney, and dip into the pit of grain, carry it up to the receiving hoppers, where it is weighed by means of a pair of scales which stand away down by the car it came from. (Some car-tracks and canals are constructed directly under the roof of the building, but often they are at one side.) Weighing hoppers are suspended on iron stirrups so as to hang free, and have room for shaking themselves a little when they work, to get rid of the grain in their paunches. Next, the grain passes down one story into the storage bins, which are made of very stout planks, and have conical metal bottoms.

The way the grain gets into the storage bins is this: You have a good many of these bins, you know, hence you let your wheat fall first on a revolving table, placed directly under the weighing or receiving hopper. Around this table are ranged a number of spouts or sluices (numbered) and radiating in every direction into storage bins. A storage bin holds from 4,000 to 8,000 bushels. When it is desired to ship corn it is first allowed to run down again to the pits in the basement, whence it is elevated to the shipping hoppers in the same way as described for the receiving hoppers. The present arrangement of elevators makes it necessary to thus lift every bushel of grain twice to the top of the building. The shipping hoppers are located just above the receiving hoppers and are the highest in the building. From the shipping hoppers long-hinged pipes conduct it to the hold of the vessel. It should have been mentioned that while the grain is *in transitu* to the shipping hopper, it is cleaned of chaff and dust by a fan-blower.

CLEANING AND LOADING.

One of the best methods of cleaning is to let the grain spread out over a sieve, the apertures of which are not large enough to let the grains fall through; then when a blast of air blows through the grain, thus thinly spread, it not only removes chaff and dust but also the "cheat" or "chess." The shrinkage by fan-blowing is about one per cent., and the loss falls on the shipper. The charge for elevating and weighing grain and storing it for twenty days was formerly 1⅛ cents per bushel; at present it is only one cent. Charge for storage an additional twenty days is ⅜ of one cent per bushel, or less. A large shipper may have two or more storage bins assigned to himself exclusively, or his corn may be graded, and mixed with other corn of the like quality. A good elevator will ship from 8,000 to 10,000 bushels an hour. The storage capacity of some of the largest elevators of Chicago and Milwaukee, New York and Baltimore, is 1,500,000 bushels, and they can handle over 300 car loads a day. At the elevator of the Boston & Albany R.R., in East Boston, two-thirds of the grain handled in a year is Indian corn. A steamship of average size will take in from 30,000 to 50,000 bushels of grain.

The method of loading ocean steamships which do not lie directly alongside the dock of an elevator is to load into lighters, and these convey the grain to the steamers. These lighters, with their great chimney-like towers, look rather queer as they bob and nod on the waves of a harbor or river. By using lighters steamships can save a day or so of their valuable time, since they can be taking in a miscellaneous cargo on one side and grain from the lighter on the other side, and both at the same moment. But in Boston there has recently been introduced a new system of loading, in connection with the great docks and elevators of the New York and New England and the Hoosac Tunnel, or Fitchburg, Railroads. And this may serve as a hint to us to transfer our attention for a little to the grain elevators of Boston.

BOSTON'S LOCAL TRADE.

The local grain trade of Boston fifty years ago, as now, was located entirely on the water front. The grain from Philadelphia, Baltimore, and Alexandria came by the Western canals and was all received in Boston by water. The points of landing were the upper part of Long Wharf, above the T, City Wharf, Mercantile Wharf, and Commercial Wharf, and the Baltimore and Philadelphia packet piers. Later, when the through trunk railway lines came, the grain locality remained the same. But it is more particularly to the foreign export trade that we design now to call attention.

The father of all the grain elevators in Boston is the old Merchant's elevator, just by the Boston terminus of the North Ferry to East Boston. It was established in 1858 by Alderman S. B. Stebbins. The Boston and Albany R.R. has two elevators in the city: one in East Boston between piers 1 and 6 of the B. & A. terminal grounds, capacity 1,000,000 bushels, and another in Boston proper, on Berkeley Street, capacity, 500,000 bushels. Another elevator is the Shawmut, on Constitution Wharf, not in operation now, but leased by the Hoosac Tunnel Dock and Elevator Company for use in case of fire or accident to their immense new docks and elevator in Charlestown.

These huge works, with those of the New York & New England R.R. Co. in South Boston, are now the finest in the city. They are precisely identical in plan throughout, having been constructed by the same architect, Charles R. McLean. The Hoosac Tunnel Company tried to purchase the territory in South Boston now occupied by the New York & New England R.R. Co., but were defeated in their intent by the latter road. The Legislature then authorized them to take possession of Hittinger's, Damon's, and Gage's wharves in Charlestown, close by the Boston bridge. Here they have constructed three great wharves covered by storage sheds and galleries.

A MODEL ELEVATOR.

In enlarging the piers and excavating for new ones, the remains of ancient wharves were uncovered, and thousands of piles had to be pulled up, and stone walls removed. The dock numbered 5 has been completed within a few months. The elevator has a storage capacity of 600,000 bushels, and so arranged as to admit of a large addition. Five ocean steamships can be accommodated here at once. The great feature of the concern is the system of grain-carrying belts by which vessels can be loaded directly from the elevator.

High up above the sheds of the docks are three long covered galleries running out from the elevator. In these galleries are rubber belts, two feet broad, and flat side up. The grain is conveyed on these belts through the galleries and is then shipped into the holds of vessels through the ordinary long-hinged pipes. The momentum of the swift running belts keeps the grain from sliding off their flat surface, and a corner is turned by the endless belt dumping its load into a sort of pipe which lets the grain fall on another belt traveling at right angles to the former. Electric lights are used in the galleries and sheds, so that work can be prosecuted at night as well as by day.

The Hoosac Tunnel Dock and Elevator Company's works are divided into three distinct portions, each with its separate interests and management, namely, the grain, the freight, and the storage departments. The docks were opened Feb. 1, 1882. The Boston & Lowell R.R. Company talk of building new elevators near their depot if they can get permission to construct new tracks across Chelsea bridge.

DUST AND INSURANCE.

The interior of a grain elevator is a most dusty-miller, pulverous, be-cobwebbed place, a vast net-work of heavy beams, and cross-braces, and hoppers, and thundering machinery. You step gingerly about among the beams, leaving tracks as you go, beholding with a rueful face the whitened appearance your black clothes are assuming, and feeling in general much as if you were in your grandmother's garret on a rainy morning. The dust and chaff ought to be swept up cleanly every day, if the insurance companies' rights are respected, for there is danger of the chaffy substance getting into the journals of the machinery and taking fire. Insurance companies require the floors to be swept every day, when they insure an elevator building.

Chicago is the greatest grain market in the world, over 100,000,000 bushels of breadstuffs being received there every year. The city has between fifteen and twenty grain elevators, with an aggregate storage capacity of 12,800,000 bushels. The business is supervised by State inspectors and by a State registrar.

The first grain elevator in Milwaukee was constructed in 1840. There are now nine, with a total storage capacity of 5,330,000 bushels. The elevators can ship over 1,000,000 bushels a day, but can receive only 500,000, owing to the greater difficulty and slowness of elevating the grain. The Milwaukee elevators are almost all owned by the trunk railway lines, which drain the great wheat regions of the Northwest. Duluth, at the head of Lake Superior (pop. about 8,000), has three elevators, and Odessa, the great wheat city of Russia, on the Black Sea, has 500 granaries.—*Commercial Bulletin.*

SEIBEL'S COKE FURNACE.

MR. SEIBEL, engineer of the *Compagnie des Mines de Campagnac*, at Cransac (Aveyron), caused to be built in 1879 a special system of coke furnace, the object of which was to utilize the property possessed by gases derived from the distillation of coal of becoming decomposed under certain conditions and of giving up part of their carbon. This system is represented in the three accompanying cuts. All coal contains, in varying proportion, carbon under two different forms. One part is in a *fixed state* and forms coke by distillation, while the other part is in *a state of combination*, especially with hydrogen, and forms the gases that are produced by the distillation of the coal.

Certain coals contain the fixed carbon in proportions that are relatively so small that the utilization of the dross, by converting into coke, does not prove a very remunerative operation.

In fact, many of these—called gas coals—contain only 57 to 58 per cent. of fixed carbon, ashes being deducted, and the best coke furnaces do not give a product of more than 90 to 95 per cent. As an offset, these same coals contain from 22 to 23 per cent. of carbon in combination, only a small part of which is employed in the carbonization.

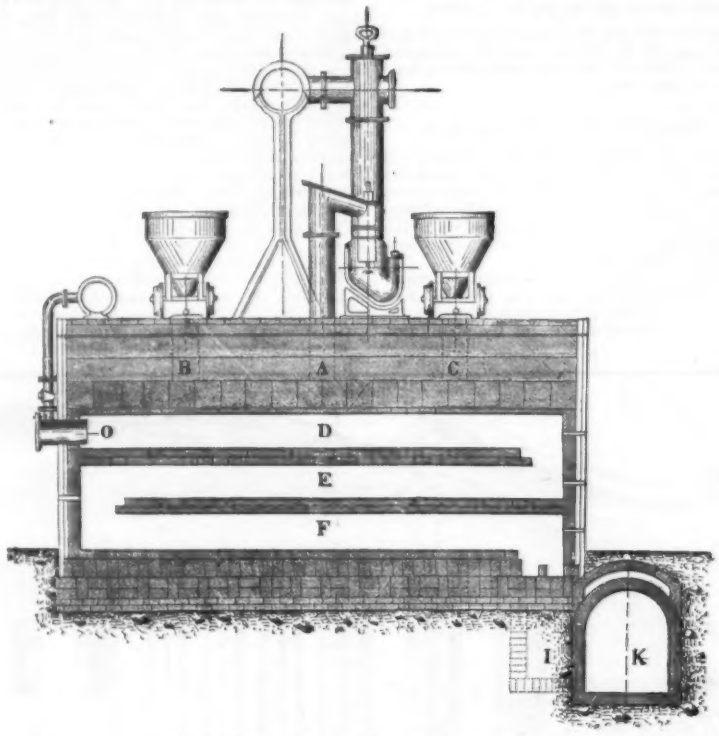
The Campagnac coal being in this category, that is, being poor in fixed carbon, Mr. Seibel has devised a mode of carbonization that permits of fixing in the coke, in the state of fixed carbon, a part of the carbon in combination. The mean product obtained with the furnaces constructed in 1879 exceeds 73 per cent., while the same coals carbonized in a laboratory crucible give 64 per cent. In the best coke furnaces the yield does not exceed 63 per cent.

As the cuts show, the masonry consists of a certain number of compartments placed alongside of each other. Each of these furnaces or compartments consists of a horizontal chamber, 6 meters in length, with semicircular vault 2 meters in height under the keystone and 0·7 of a meter in width. The height of the arch butments, from the sole to the springers, is 1·65 meters.

In the center of the furnace vault there is an aperture, A, through which pass the products of distillation. Two others, B and C, located, like A, in the center, serve as mouths for charging. The furnace is closed at P, at both extremities, by doors having two superposed leaves. These doors have to be luted with care, as do also the mouths, B and C.

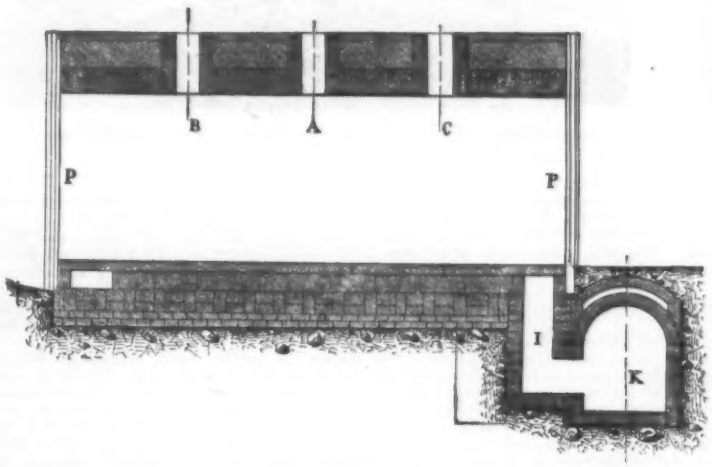
The partitions between the furnaces contain three horizontal flues, D, E, and F. In each partition the upper flue, D, receives through O the air and gases that are inflamed, and that heat the furnaces so as to effect carbonization in a closed space.

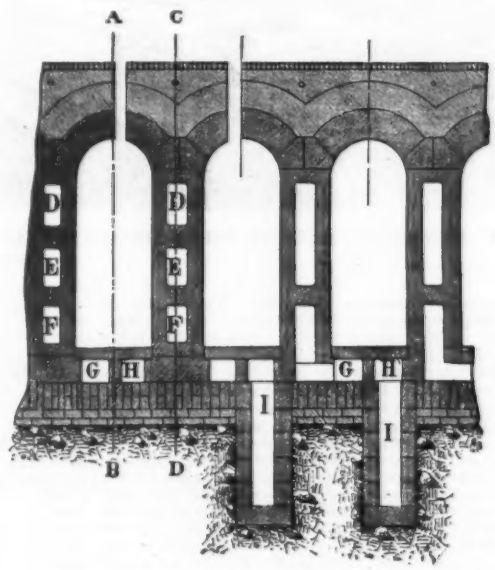
After traversing the flues, D, E, and F, the gases pass through the flues, G and H, so as to heat the sole of the furnaces, and flow through I to a large collecting chamber, K, which sends them to a draught chimney located at one of the extremities of the plant.



SEIBEL'S COKE FURNACE.

Carbonization is effected as follows: The furnace is charged with about 5,000 kilogrammes of damp coal dross. Its temperature, which was from 1,000° to 1,200°, falls to 400° or 500° after such charging, but soon rises again at the upper part. Carbonization begins above, and descends progressively. The gases of the lower layers, sucked up by an extractor, rise toward the aperture, A, and traverse, while doing so, a spongy mass of coke in process of formation. These gases, being in a nascent state, and at a high temperature, are easily decomposed, and give up a portion of their carbon, which latter is deposited in the pores of the coke.





SEIBEL'S COKE FURNACE.

Thus is explained the increase in the product, as well as the increase in the density and hardness of the coke.

The products of distillation make their exit through special pipes adapted to the apertures, A, and pass into a drum, and then into a collecting pipe which leads them to a tar-clearing tube formed of a cylinder 1·3 meters in diameter and 5 meters in height. The expansion that occurs in the gases in this tube favors the deposit of a certain quantity of tar. On leaving this, they give up the rest of their tar in a Servier condenser, then circulate through two washers which free them from ammoniacal products, and finally reach a Bourdon extractor, which sucks them up and forces them into the furnaces again through the pipe, O. The process takes forty-eight hours.—*Chronique Industrielle.*

A NEW ORE SEPARATOR.

CONCERNING the new method of separating minerals invented by Herr Franz Buttgenbach, Lintorf, Westphalia while the separation of intimately intermixed minerals from each other has been effected hitherto mainly by taking advantage of differences of density, structure, or capacity for being rendered magnetic by calcination, use is made by Herr Buttgenbach of the properties of minerals evinced in differences of specific cohesive strength. The separation of minerals of unequal hardness, and by reason of their greater or less susceptibility to break down into fragments of different sizes, is not possible with the ordinary crushing or stamping mill; but it is different when the mass is thrown violently against a hard resisting surface, in which case, if the velocity is properly proportioned, only the more brittle substances are broken. In order to obtain a proper separation of iron pyrites and zinc blende, Herr Buttgenbach has been led to experiment on the use of Vapart's centrifugal breaker, not only as a crusher, but as a separating machine; and the apparatus which we illustrate is the outcome of his experiments.

In our engravings (for which, and the present particulars, we are indebted to *Glaser's Annalen* and *Iron*), the arrangement of such an apparatus is shown in vertical section and plan by Figs. 1 and 2. A cylinder 900 millimeters high, and of an inner diameter of 1,100 millimeters, is provided with three interchangeable chilled rings, which are fixed in the interior at three different heights in five segments. These segments are toothed, as shown in Fig. 3. The

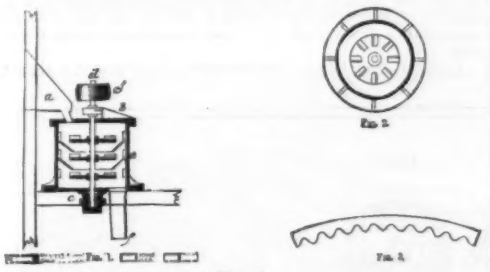


FIG. 4.

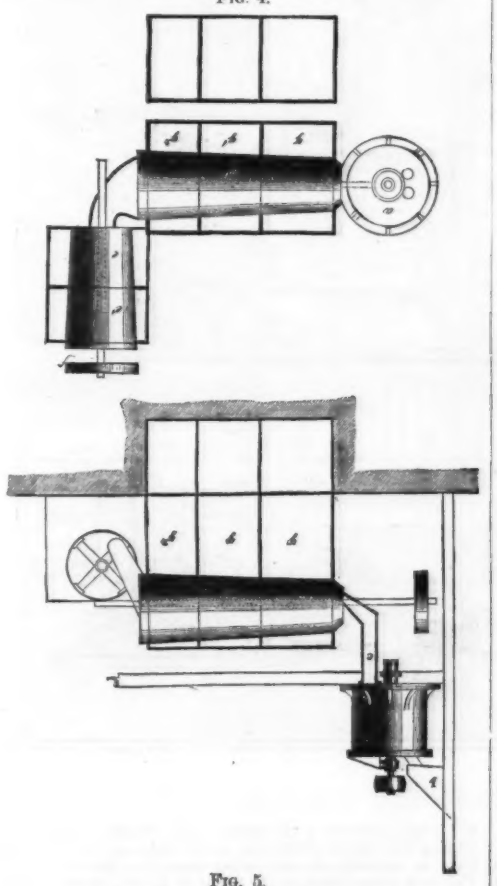


FIG. 5.

A NEW ORE SEPARATOR.

axis, *d*, passing through the fixed cylinder, is guided at the points, *b* and *c*, and is moved by the pulley, c^1, keyed to it. To the axis three horizontal disks are fixed, upon the periphery of each of which eight angles are fitted, in the arrangement as shown in Fig. 2. The axis with the disks is revolved at great speed; the substances falling through the feeding orifice, *a*, are precipitated toward the center of the upper disk, and are projected by centrifugal force against the chilled rings, and then drop down upon a sloping basin, *e*, arranged like a funnel, which brings them upon the second disk toward its axis, and thus the same movement is twice repeated before the substances reach the opening, *f*. Now, it depends upon the speed at which the disks revolve whether the particles of ore put in at *a* are broken up by being thrown three times against the rolls of the cylinder, or, rather, whether the precipitated bodies, at a given velocity, leave the apparatus in fragments or whole, according to their specific hardness or cohesion. At a speed of 800 revolutions per minute, in this apparatus lumps of iron pyrites of from 20 to 25 millimeters diameter will leave it either as dust or grains of 1 to 1¼ millimeters, whereas with 400 revolutions they will come out of it but little touched. With 800 revolutions, however, zinc blende is crushed to the finest flue stuff, while with 300 to 400 revolutions it leaves the apparatus partly as dust and partly in grains of ½, 1, 2, and 3 millimeters. If, now, a mixture of pyrites and blende is put into the apparatus, and passed through it at a speed of 400 revolutions per minute, the pyrites leave it in almost the same state in which they entered it, while the blende is very finely reduced, and the separation of the two minerals may then be easily effected by a simple sifting process.

After it had been determined by various experiments that separation could be easily effected in this way, the arrangement described was adopted. But in order to carry out the operation systematically, and in a practical manner for continuous working, the arrangement illustrated by Figs. 4 and 5 is recommended. In Fig. 4, *a* is the Vapart apparatus, which is filled at *b*. The crushed ore is passed through the funnel, *c*, into the drumsieve, a^1, which has a fall of 60 to 1,000 millimeters, and revolves at a speed of 9·2 revolutions to every hundred of the mill. This drum is divided into three parts, with perforations of 1, 2, and 3 millimeters respectively. The coarser stuff passes through a second drum, *e*, which has two divisions, having holes of 6 and 8 millimeters respectively. Pieces of over 8 millimeters drop out at *f*. This drum has a rise of 60 in 1,000 millimeters, and is driven at a speed of 8 revolutions to every hundred of the Vapart crusher. If, now, a mixture of iron pyrites and zinc blende of a size of 20 millimeters is put into the drum, the latter revolving at a speed of 300, over 80 per cent. of the blende contained in the mixture is crushed into three different sizes, which are separated in the three divisions, g, g^1, g^2. The first two divisions give almost pure blende, the third is yet intermixed with grains of iron pyrites, but enriched threefold as compared with the material as first put in. The division, *e*, gives iron pyrites with still a few large-sized lumps of zinc blende. In most cases, the third division, g^2, furnishes the blende enriched to an extent which renders further treatment unnecessary. The grains of the first division, *e*, where about 5 to 10 per cent. of the whole drops out, may be charged profitably again; the second division, e^1, furnishes almost pure iron pyrites, also the discharger, *f*.

Experience has shown that the treatment is then most successful when the particles are as nearly uniform as possible. The operation may be carried on wet or dry, but in the latter case it is essential that the material should be as free from moisture as possible, as the powder, if damp (with about 4 per cent. of water), easily stops up the holes in the sieves, and clogs the segments of the apparatus. The dust is also a very great inconvenience, but the use of a small jet of water will do away with it, and the separation will then also be more effectual, and the product cleaner. The separation of the two minerals is not completely effected by this method, as the projecting corners of the grains of pyrites are liable to break off, even at moderate speeds of of the apparatus, and to become mixed with the blende. But for commercial purposes the result is almost perfect, as after the operation only a very small percentage of the two minerals remains mixed. The economic value of this new method of separation is shown by the following calculation: Mixed ores with equal propertions of blende and pyrites are worth at the highest valuation about 10*s.* per ton, and are not easily disposed of at that price. When subjected to the treatment above described, however, the products are 11 cwt. of pyrites, with 5 per cent. of blende, worth 9*s.* 6*d*; and 9 cwt. of blende, worth 31*s.* 6*d*; giving a total of 41*s.* for the separated products. Taking the cost of the raw material at 10*s.*, and the working expenses at 9*d.*, the profit on the treatment appears to be 30*s.* 3*d.* per ton of stuff treated. The amount of material that can be passed through once and crushed in a Vapart mill is about 5 tons per hour, so that a single apparatus will be sufficient for even a very productive mine, as mixed ore of this kind never forms more than a comparatively small portion of the total output. It need hardly be added that this method of separation is not confined to iron pyrites and zinc blende; it may be applied in many cases in which the materials of various degrees of cohesion have to be disintegrated. We understand that this system has been successfully introduced in Westphalia, and is giving very satisfactory results in working.

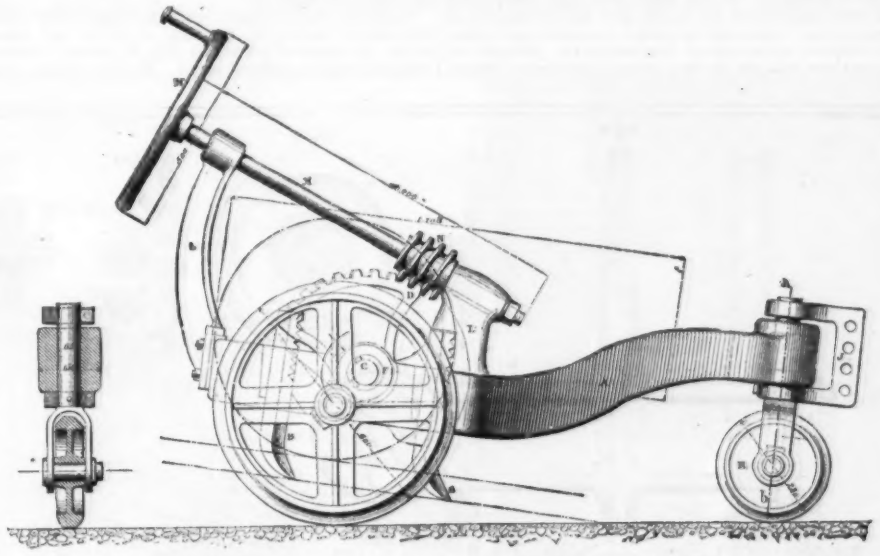


FIG. 3.—SECTION THROUGH AB.

FIG. 1.—ELEVATION.

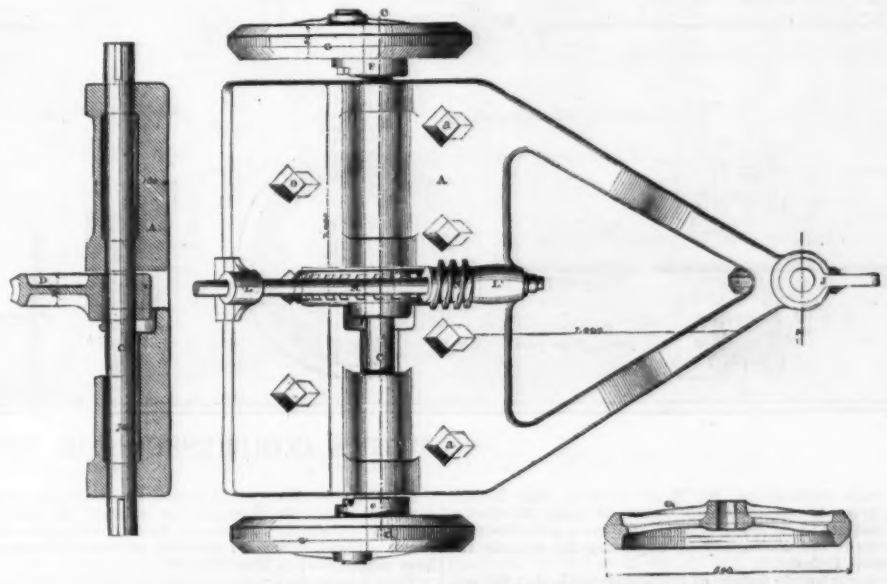


FIG. 4.—SECTION THROUGH CD. FIG. 2.—PLAN VIEW. FIG. 5.—SECTION OF WHEEL.

HARROW FOR BREAKING THE SURFACE OF MACADAMIZED ROADS.

WHEN a macadamized road is to be newly metaled, it is well to facilitate the union of the new with the old materials by scraping up or picking over the surface. If such a precaution be neglected, and the material be spread over the old road without breaking up the surface of the latter, the risk will be run of having it removed in slabs at the time of frosts, or completely disintegrated when it has been, through wear, reduced to a thickness of 3 or 4 centimeters.

This operation is ordinarily performed on macadamized roads by means of picks, at a cost which varies with the locality, but which is always too great a one to allow the method to be employed as a rule.

In order to put this method of treating roads within reach of all who are charged with keeping such in repair, Mr. Mothiran, an overseer of bridges and roadways, has devised a harrow for the purpose. This apparatus, which is shown in the accompanying engravings, consists of a strong frame of cast iron, A, containing seven apertures, *a*, into which are inserted a like number of square steel teeth, B, which are 35 millimeters in thickness, and the points of which are curved and tempered.

This frame is traversed in the rear by an axle, C, that carries keyed to its center a toothed sector, D, and, at its two extremities, two cranks, F, on the pins of which are mounted two wheels, G G^1. These two cranks are stationary on the axle, and the two wheels are free on the crank pins.

In front there is a steering wheel, H, and a ring, J, to which to hook the trace-chains.

Upon the upper surface of the frame there are fixed two supports, L L^1, that serve to hold a shaft, *m*, which is inclined toward the front. This shaft carries, keyed to its upper extremity, a hand wheel, M^1, and, at its lower, an endless screw, N, which communicates motion to a toothed sector, D, that traverses the frame through an aperture formed for the purpose.

By means of this endless screw, the hind wheels may either be lowered so as to cause the teeth to penetrate to any required depth, or be lifted so as to free the teeth from the surface and make the apparatus easily transportable.

This tool requires eight horses for traction and three men for maneuvering, and is capable of picking, on an average, 1,200 square meters of road surface per hour.—*Annales Industrielles.*

MEGY'S COMPRESSED AIR WHIM.

In mining operations, as is well known, the excavated material is brought to the surface in buckets suspended from cables that wind around drums belonging to powerful whims. These latter are in most cases actuated by steam motors devised especially for the purpose. For internal service, however, the use of steam whims offers several disadvantages: First, the escaping steam forms a discommoding mist. Second, there is more or less difficulty in putting in the generator. Third, there is the danger due to the presence of fire damp, which is easily inflammable on contact with a body in a state of combustion. So, for some time past, compressed air has been substituted for steam, and the application of that agent is now beginning to extend, inasmuch as it offers the still further advantage of ventilating the galleries by supplying them with the air that escapes from the cylinders.

For such applications, Mr. Megy, of Paris, has devised several types of compressed air whims, of moderate dimensions, that are easily transportable, and the details of which are shown in the accompanying engraving taken from the *Publication Industrielle.*

The characteristic feature of this apparatus is that the motor revolves always in the same direction, and that the change in running is effected by means of two gearings mounted upon the main shaft and maneuvered by one and the same lever. These gearings serve at the same time as moderating brakes, and permit of giving the running apparatus any velocity that may be desired, instantaneously, and without the least shock. The whim herewith represented is one that is employed at the Saint Etienne coal mine. Its power is 2,000 kilogrammes, and its velocity is one meter per second.

The whim is shown in external front and side view in Figs. 1 and 2. Fig. 3 shows a part of a vertical section made on the line 1–2. Fig. 4 gives a partial horizontal section, on a scale of $\frac{1}{10}$, passing through the axis of the drums.

The frame is formed of two hollow cast iron sides, B, held at a distance of 1·97 m. apart by three tubes, *b*, which are likewise of cast iron. The cross staying of the two sides is further completed by the different shafts.

Each of the driving cylinders is 405 millimeters in length, and 215 millimeters in diameter. The piston has a stroke of 310 millimeters.

The compressed air is led into the valve box by the pipe, *m*, and its entrance may be regulated by means of a valve that is capable of rising and falling, and acting upon the lever, m^1. Distribution is effected by means of an ordinary expansion slide valve, actuated by a small connecting rod coupled with the crank shaft, m^2.

Each of the two drums, over which winds a flat cable, consists of a cast iron disk, N, keyed to the shaft, and having on each side a series of eight wooden arms, N^1, of 0·06 m. × 0·06 section. These latter are set into projections cast in a piece with the disk and are held in place by bolts, *n*. This arrangement may be very well seen in Fig. 4. The eight arms of each series are, in addition, united by an iron circle, n^1.

The brake pulley, F, which is 1·46 m. in diameter, is cast in a single piece. Its hub is bolted to the disk, N, as shown to the right side of Fig. 4. The rim of this pulley is, as usual, of wood held in place by a band of steel, *f*, whose extremities are attached to the lever, f^1, that may be seen represented by dotted lines in Fig. 1. Upon this lever, f^1, slides a counterpoise, F^1, which is shown in longitudinal section in Fig. 5, and in transverse section in Fig. 6. It will be noticed that this counterpoise is provided with an opening, into which slips the head of a bolt that serves to hold the strap, *f*, which carries a small roller bolt embraced by the extremity of the suspension chain, f^2.

Gearing and Driving Mechanism (Figs. 1, 2, 7, and 8).—The two motors act always in the same direction directly upon the shaft, C, to whose extremities are keyed, at 90° apart, the cranks, m^2. This shaft transmits its motion to the parallel shaft, D, either in one direction by means of the cogwheels, *c*, c^1, or in the other by means of two wheels, *d*, d^1, and of a third and intermediate one, d^2.

A double gearing permits of connecting at will either the pinion, *c*, or the pinion, *d*, with the shaft, C, and of consequently giving the shaft, D, a motion either in one direction or the other. As we have already said, such motion is transmitted to the shaft, G, of the wheels, N^1, by the pinion, *g*, and the large wheel, g^1.

Upon the shaft, C, and toward its center, slides a sleeve, *a*, that may be moved to the right or left of the axis of the whim by means of a lever, A (Fig. 2), whose inclination is indicated upon a divided sector. To this sleeve, which the shaft, C, carries along in its revolution, are fixed two chains, a^1 and a^2 (one to the right and the other to the left), whose opposite extremities terminate in two identical coupling gears. It will suffice to describe the one of these that we have represented in Figs. 7 and 8

This apparatus consists essentially of a hollow drum, E, cast in a piece with a hub which is keyed upon the shaft, C, and which is somewhat prolonged to the left and right so as to receive on one side the pinion, *d*, and on the other the four armed socket, E^2. A similar socket, E^2, is cast in a piece with the pinion, *d*, and the two sets of arms are united by a rim, E^1. This whole arrangement is loose upon the hub of the drum, E.

Between the external circumference of the drum, E, and the internal surface of the rim, E^1, there is interposed, with a certain play being allowed it, a curved spring, *e*, upon which is placed a band of copper, e^1. This spring, which tends to thrust the copper band against the interior of the pulley, E^1, is held in the center by a key inserted into a hollow space in the drum, E. The free ends of the spring are united by a prolongation of the chain, a^3, which passes over a series of rollers in the interior of the drum.

If no traction be exerted upon the chain, the curved spring, whose stress has been regulated before putting it in place, will establish a connection between the drum, E, and the arrangement, E^1, E^2, E^3, *d*, and the shaft, C, will then carry along the pinion, *d*, and will consequently drive the shaft, D. If, on the contrary, the chain, a^3, be tautened so as to overcome the effort of the spring to straighten, the latter will cease to thrust the copper band against the interior of the pulley, E^1, and the two shafts, C and D, will no longer be in gear.

When the sleeve, *a*, is in the axis of the machine, that is to say, when the lever, A, is vertical, the length of the chain is such that the ends of the two springs are made to approach each other, so that neither of the coupling gears operates. If, on the contrary, the lever A, be inclined to one side, to the right, for example, the chain will be loosened on this side and the corresponding coupling will operate; but, if the lever be inclined toward the left, it will be the corresponding coupling gear that will operate, and the control will be effected through the wheels, *d*, d^2, and d^3; the direction of motion of the shaft, D, will be reversed, and consequently that of the drums, N^1, the two motors always preserving, as we have said, the same direction in running.

Maneuver of the Brake by Hand (Figs. 1 and 4).—To operate the regulating brake it is only necessary to leave to itself the counterpoise, F^1, which, during a normal running, is lifted by the chain, f^2. This latter, after passing over two guide rollers, is attached (as seen in Figs. 1 and 4) to a strong nut, v^1, which is movable on a screw, *v*, that revolves only when the hand wheel, V, is acted upon. A few turns of the latter suffice to permit the counterpoise, F^1, to so act at the extremity of the lever as to lock the brake.

Automatic Maneuver of the Brake (Figs. 4, 9, and 10).—It now remains for us to explain the automatic operation of the brake, by a reference to Fig. 4.

It will be seen that to the extremity of the shaft, G, is keyed the conical friction pulley, H, which carries along one of the friction pinions, *i* or i^1, that are cast in a piece with the sleeve, I. This latter is capable of sliding on the shaft, K, and of carrying it along in its motion. This shaft, K, is supported by the double bracket, I, which is bolted to the frame, and by an angle iron at its opposite extremity; and it must always revolve in the same direction. For the latter reason the pulley, H, has a peculiar arrangement that we shall explain by the aid of Figs. 9 and 10, the first of which represents a front view of it, and the second a vertical section.

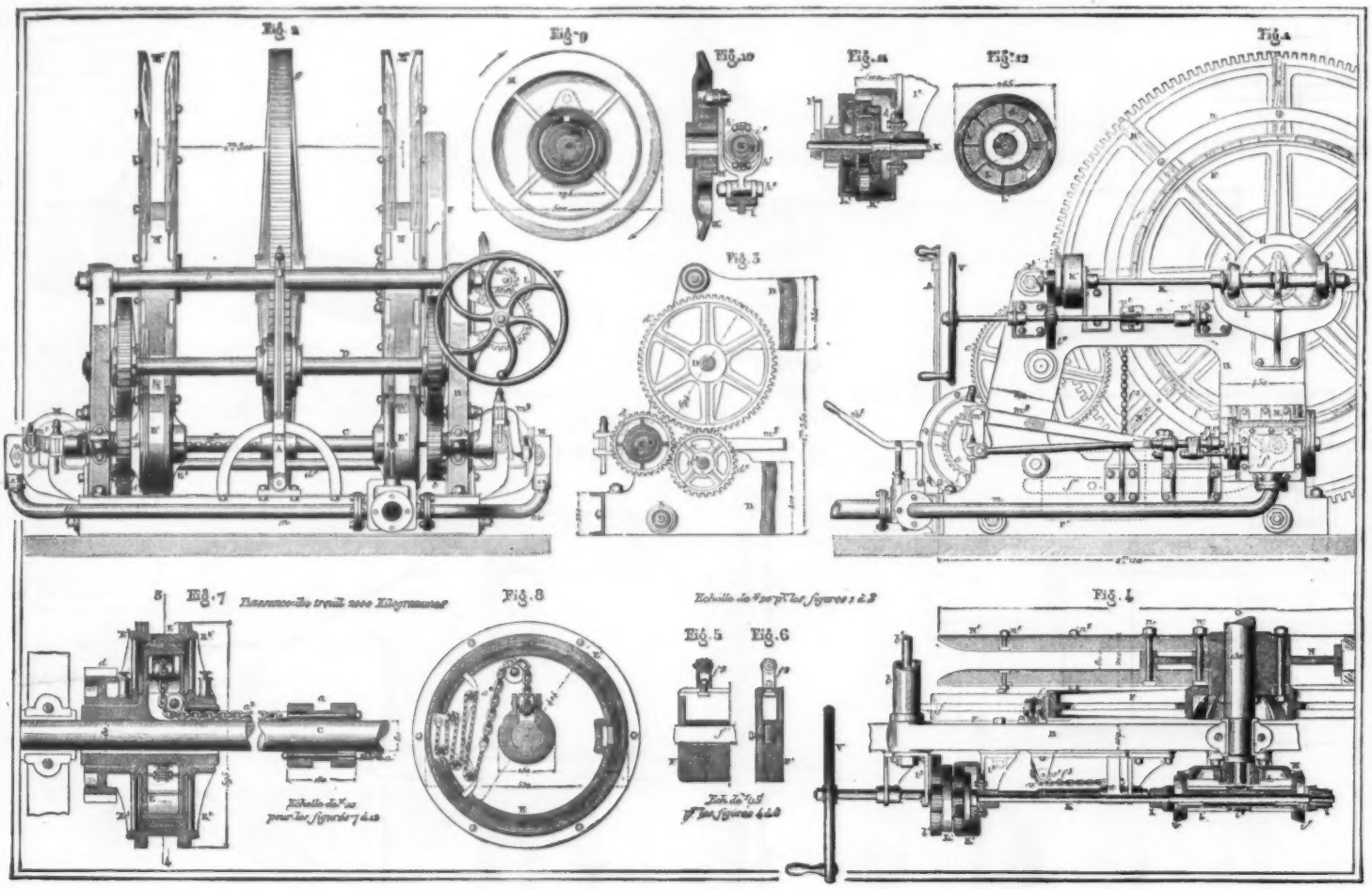
Upon the hub of the friction wheel, H, is placed a socket, H^1, which carries a projection with whose extremity is jointed the longer of the two branches of a fork, *h*, which itself is capable of oscillating around a fixed axis, h^2. This fork corresponds to the collar, i^2, in two pieces, which, is fastened around the sleeve, I^1 in its center.

The wheel, *h*, is cast in a piece with a ring, *h*, concentric with the socket, H^1. The interval between these two pieces is occupied in part by a bent spring, which is covered with a band of copper, and which rests against the interior of the ring, *h*. The extremities of the spring carry two tappets held between two stops cast in a piece with the socket.

This arrangement, called by Mr. Megy a "limiter of stress," works as follows: If, for instance, the wheel, H, is revolving in the direction of the arrow, the tappet to the right will push back the corresponding stop and cause an oscillation to the right of the projecting piece of the hub as well as an oscillation of the fork; and this latter will then move the sleeve, I, in the same direction, and put the pinion, *i*, in contact with the wheel, H. Motion will then be transmitted to the shaft, K, which will revolve backward. If we suppose that the shaft, G, is revolving in a direction opposite that shown by the arrow (Fig. 9), we shall see in the same way that the fork, h^1, will incline to the left and cause the pinion, *i*, to engage with the wheel, H, and that the shaft will again revolve backward.

The automatic mechanism, properly so called, of the brake, is shown in longitudinal and transverse sections in Figs. 11 and 12. Upon the shaft, K, is keyed the disk, *k*, that carries the axles of two small toothed pinions, k^1, which, when they are carried along in the motion of the said disk, cause a revolution of the pinion, *l*, which is loose on the shaft, K. The pinions, k^1, in this motion, engage with an internal fixed toothing cast in a piece with the cylindrical box, K^1, which is bolted to the angle iron, I^2.

The pinion, *l*, is prolonged by a socket provided with a



MEGY'S COMPRESSED AIR WHIM.

series of radiating partitions that constitute chambers in which are placed pieces of lead, L. These latter, eight in number, are kept in place by a spring that surrounds them, and that tends to bend inward, that is to say, a spring whose extremities tend to approach instead of recede, as in the ones before mentioned. This spring, which is likewise covered with a copper band, is inclosed, like the pieces of lead, in the interior of a cylindrical box, L^1, which is cast with the pinion, l^1, and is loose upon the shaft, K.

As a result of such an arrangement, if the velocity of the shaft, K, happen to increase in an abnormal manner, for any reason whatever, the force that will be developed will cause the pieces of lead, L, to approach the circumference, and, overcoming the resistance of the spring, oblige this to bear against the interior of the box, L^1, and this latter will then be carried along by the shaft, K.

Motion is transmitted by the pinion, l^1, and the wheel, l^2, to the screw, v^1, and from this results a motion of the nut, v, and, consequently, a locking of the brake.

It will now be understood that the nut, v, always having to move from right to left to lock the brake, the shaft, K, must always revolve in the same direction—backward—whatever be the direction in which the shaft of the drums, N, is revolving.

The arrangement of the pinions, k^1 and l, was adopted for the sole purpose of increasing the velocity of revolution of the latter, in order to increase the centrifugal force, which, without that, would have been insufficient to move the pieces of lead, L.

In many applications, the parts for an automatic maneuver of the brakes do not exist, and, in such cases, there is arranged upon the axle of the intermediate pinion, d^2, on each side, an apparatus very analogous to the one just described, and the purpose of which is to moderate the velocity of the machine.

THE PALAZZO VENDRAMIN-CALERGI, VENICE.

THE palace where, on the 13th of Feb., 1883, Wagner* died is one of the most striking buildings on the Grand Canal; and Mr. Hare, in his admirable "Handbook," chronicles it as one of the few Venetian palaces which are well kept up; while it has a garden beside it rich with evergreens, and decorated with gilded railings and white statues which cast long streams of snowy reflection down into the deep water. It was built in 1407 by Pietro Lombardo for Andrea Loredan. A hundred years, after it was sold to the Duke of Brunswick, who in his turn sold it to the Duke of Mantua. In 1589 it was bought by Vittore Calergi, whose family becoming extinct in the male line, it then passed to the Grimani and subsequently to the Vendramini, by whom it was sold in 1842 to the Duchesse de Berri, the mother of the Comte de Chambord. The *façade*, which is shown in our engraving, is built of gray Ionian stone, with pillars of Greek marble and medallions of prophyry. The whole building is a magnificent specimen of the early Renaissance style; and, as it can be seen for a small fee, it is well worthy of a visit even from a passing tourist, for the interior is singularly elegant, and the palace contains several exceedingly good paintings.—*London Graphic.*

* For portrait and biographical sketch see SUPPLEMENT 379, April 7, 1883.

COLOR IN ARCHITECTURE.

By GEORGE AITCHISON.

AT a recent meeting of the Royal Academy, Mr. George Aitchison, A.R.A., delivered a lecture to the students on the subject of "Color," a topic illustrated by numerous examples of tiles and mosaics, and copies of decorative work by the Japanese, Chinese, Indians, Persians, etc. The President, Sir Frederick Leighton, occupied the chair.

The lecturer said he proposed to confine his remarks to color as applied to the outsides of buildings. He should treat of the position color held to man; the passionate love mankind had for it, whether it was exhibited in Nature's works or in works of art that mankind had directly employed to adorn their temples or dwellings; and show that color had almost always been used to enhance the beauty of buildings. Color, if we included white with its gradations to black, was the only visual means by which things could be known, for if there were persons so unfortunate as to be color-blind, they saw only the shades and shadows of things.

By the general consent of mankind, the arrangement of certain colors in certain proportions caused delight—in fact, for the bulk of mankind Nature had made almost every phase of earth, air, fire, and water beautiful. When we went into the country our enjoyment mainly consisted in feasting our eyes on the beauty of color. Every poet or rhapsodist had descanted on the beauty of trees, flowers, meadows, and mountains, the sea and the river, the lake or the waterfall, the moon, the starlit sky, the sunshine and clouds, from Homer's "rosy-fingered Aurora" to "a looming bastion fringed with fire" of our Poet Laureate. Why were painters courted and sculptors neglected but because the former dealt in color that all knew and loved, and the latter in a white abstraction from "the human form," which most of us had hardly seen.

We loved landscape painting because it preserved for our admiration such evanescent phase of Nature's color that struck the artist as most lovely or most harmonious. In Turner's picture of "Ulysses deriding Polyphemus," though we had the golden galleys, the colored dresses, the main beauty was in the ocean and the mountains, and the sky ribbed with the flaming spokes of the rising sun. We loved figure painting chiefly because it gave us the exquisite and subtile tones of flesh, and its harmony with the color of hair and eyes, with lovely and gorgeous robes, with armor, with sky, water, landscape, or architecture.

Titian was particularly fond of outdoor effects, and sometimes his most gorgeous coloring combined flesh and robes, trees and water, architecture and sky. As examples, the lecturer referred to Titian's "Bacchus and Ariadne" in the National Gallery, and "Virgin and Child" in the Louvre, in which the collocation of various colors and tones combined to make a gorgeous and enchanting whole. In like manner Bonifazio's "Supper at Venice," and his "Finding of Moses" in the Brera, Tintoretto's "Miracle of St. Mark," Schiavone's, Veronese's, and La Hooze's works also showed that superb pieces of color, with splendid harmonies, could be culled from Nature and put on a canvas to enchant us.

A building could, he believed, be substituted for a canvas, and be made equally superb in color. All had admired the laborer's whitewashed cottage, latticed with rose-trees, with their green and golden leaves, and their pale, yellow, pink, or blush roses. They had noticed a red-brick cottage trellised with roses, the firethorn, or the purple jasmine of Japan, with clematis, wistaria, the scarlet-runner, or the passion-flower. Either cottage was beautifully ornamented when covered with the grapevine full of bunches of green, purple, or black grapes, not to speak of those houses wholly green with ivy, or glowing with the red leaves of the Virginia creeper. It was only during the last century, and at occasional epochs, that buildings had been left to the monotone of one material, and we ought not to forget that the word "monotonous" neither conveyed the impression of admiration nor delight.

The Persians, the Assyrians, the Egyptians, the Greeks, the Etruscans, the Chinese, the Japanese, the Mexicans, the Peruvians, the Arabs, Moors, and Turks all enriched with color; nay, he believed the Gauls, the Germans, the Scandinavians, the Goths, Huns, and Vandals did the same, and all that group of nations whom we called the Mediævals made their buildings at least striking by the aid of color. Why had color disappeared from the exterior of modern buildings? Though in this country Puritanism might have something to answer for, in Italy Palladio had more, for he had said that "White was more acceptable to the gods." Beyond these two factors, the lecturer believed the main reason was that this adornment was mostly of perishable materials, and in bad times were not renewed, so that many generations had grown up without ever seeing a colored building: and any novelty shocked mankind's conservative instincts.

He could remember the storm raised by Owen Jones' coloring of the Exhibition Building of 1851. He had been to Egypt, and had also studied the coloring of the Moors; his critics knew no coloring but that detestable application of gold on white they had seen at Versailles, or perhaps some pale pea-green and gold in their own drawing-room. Mr. Aitchison quoted from Viollet-le-Duc to show the important part played by color in French buildings of the Mediæval period, as in the painting and gilding in their doorways in the west front of Notre Dame at Paris, the front of Amiens Cathedral, and other edifices where the external color was much more vivid than that employed within. As proof that the Greeks used color, he might mention that Mr. Watts saw a fragment of foliage at Halicarnassus, just dug up, painted with vermilion, turquoise green, and golden yellow. Of course, figures in white marble with a polished surface, and of translucent substance, were not covered with opaque distemper; the flesh was delicately glazed with transparent color.

In the collection of Mr. Alma Tadema's pictures, now on view at the Grosvenor Gallery, that exquisite colorist had shown in many pictures figure-sculpture painted, from which one could form an opinion of the effect. In many parts of Italy basso-rilievos were painted exactly like pictures, not to speak of the colored wares of Lucca della Robbia and his school. Signor G. Boni, in charge of the restorations at the Ducal Palace, Venice, under the architect-in-chief, found traces of gold and color on the ornaments executed before 1508. Philip de Comines, Ambassador to Charles VIII., who visited Venice in 1495, wrote that "the houses are very large and high, of good stone; the old ones all painted. The others, built in the last 100 years, have their fronts of white marble, which comes from Isturia, 100 miles from there, and besides many great pieces of porphyry and serpentine on the fronts."

In some pictures by Carpaccio, we saw how the houses of Venice were formerly ornamented with color, and some

THE PALAZZO VENDRAMIN-CALERGI, VENICE, WHERE RICHARD WAGNER DIED.

with painting and gilding. In the illuminated MSS., and in mosaics, we saw buildings represented of much earlier date than the oldest absolute paintings, and these were mostly shown as wholly or partially colored. The lecturer quoted examples from the pictures by Giotto, Benozzo, Luca Signorelli, Pinturricchio, to illustrate the way in which the Italian builders of the Middle Ages treated their houses. He would refer, in passing, to the buildings of Persia, because in that country were to be found the most magnificent expositions of extreme color applied externally, and executed too in that splendid and imperishable material —enameled earthenware. Their flat walls, cylindrical minarets and drums, bulbous domes, half domes, and honeycombed work were all covered with richly-colored tiles, painted or inlaid in the most beautiful and intricate patterns, and white, blue, green, yellow, red, and black were there used in their fullest intensity.

Mr. C. Purdon Clarke described the effect of this colored architecture as being splendid, and satisfying to this degree, that he not only did not desire to see it altered, but could not see how the color could be improved. Through the courtesy of Sir Philip Owen and Mr. Armstrong, the lecturer was able to exhibit some magnificent tilework from Ispahan, and some drawings of splendid tilework from India, in which unusual harmonies were got with a rich brown and pale fawn color on a magnificent deep blue ground. These examples had been acquired for South Kensington. Splendid color was, as a rule, only to be found in the East, or had been derived from it. He strongly suspected all the fine color in Europe came directly or indirectly from the East.

First, it filtered through to Constantinople, and skilled men were sent thence to execute works in different parts of Europe. The churches, mausoleums, and mosaics of Ravenna were, the author believed, executed by architects and artists from Constantinople, and so also were, probably, the mosaics of the churches in Rome, Sicily, and elsewhere. We know that St. Mark's, Venice, and the Mihrab of the mosque at Cordova, were done by them. The Crusades enabled the Westerns to see something of the glories of the East, and the plunder familiarized those at home with Oriental color and workmanship. Afterward this impression was kept up by the traders who visited the East, and trafficked in its goods.

There was little doubt that that very effective method of outward adornment, horizontal stripes in different colors, was brought from the East. We saw the red and black stripes in the buildings at Cairo repeated in the cathedral at Genoa, the buildings at Pisa, Florence, and Siena, though in Italy the bands were mostly of dark green, serpentine alternating with white marble. St. Mark's was at this day wholly covered with slabs of Greek, African, verde antique, and other beautiful marbles. Over the doorways were mosaics on a gold ground, while smaller pieces, mosaic as ornaments and borders, were interspersed on its facades, and its crockets were gilt.

On the Doge's Palace was a well-known example of delicate pink and white diaper. The campanile and cathedral at Florence were covered with pink and white marble, having borders and inlaid work of green serpentine. The effects of red brick with white stone were too well known in the form of dressings, strings, cornices, stripes, and checker-work to need description. In many Italian buildings happy effects were got by filling in the ground of ornament with mosaic of green, gold, red, black, or other color. Perhaps the most striking example of modern external polychromy was a palace at Berlin. The walls were faced with black and red compressed tiles in a diaper, the window-dressings were in majolica, and the frieze was in colored glass mosaic on a gold ground. When the lecturer saw this palace, some eight or nine years ago, it was not pleasant to reflect that the tiles were probably English, the majolica Minton's, and the mosaic from the English Company at Murano, and that no such complete attempt at polychromy had been made in our own country.

In the Opera-house at Paris, polychromy of a very delicate and dignified character was obtained by means of marble, bronze, and gilding, with a very slight admixture of enameled earthenware on the flanks. M. Charles Garnier had thus sketched a dream of the future of Paris: "The grounds of the cornices will shine with eternal colors, the piers will be enriched with sparkling panels, gilded friezes will run along the buildings, the monuments will be clothed with marbles and enamels, and the mosaics will make everybody love movement and color." M. Paul Sedille, one of the apostles of color, had already enriched parts of France with buildings wholly or partially colored; and he was converting what the Romans called an "island," and the Americans a "block," of buildings in Paris into one huge building for the display of drapery, two sides of which were already built. The upper part of each of the towers flanking the facades, built of brilliant white stone, were paneled with glass mosaic on a gold ground. The scrolls of green and blue, with white and purple-brown flowers, formed the ground of the owners' names in pure white letters, edged with black, and the stone frame to this was enriched with jewels in a gold setting. Each bay between the pilasters was wholly of glass, iron, and bronze; the iron painted dark gray and the bronze gilded. Each story was enriched with a frieze of gold mosaic and slabs of marble set in the bronze. The roof was of zinc scales, and the dormers and ridge ornaments were of cast-iron, painted black and partly gilded; the turrets above the domes of the towers were also gilded, while the balconies supported gilt festoons. The front of the Turkish baths by M. Parvillee, the author of "L'Architecture et Decoration Turques," was faced with enameled tiles of Turkish patterns and colors.

M. Sedille had spoken recently with approval of certain halls of public establishments in London, which he remarked were "completely covered with painted earthenware, developing decorative composition with true style." Even if, Mr. Aitchison added, these pioneers of color had in our judgment failed, we owed them our thanks for having been the first to emancipate us from drab, and for having opened to us that path which would eventually cover London with beautiful and imperishable color.

The lecturer then described several attempts which have more or less successfully been made to brighten our London streets. One of the first of these efforts was a house in the Avenue road, into which M. Hector Horreau introduced slabs of majolica. M. S. S. Teulon designed the canopy to a fountain at the corner of Great George street, Westminster—a work once brilliant with color, but now nearly black from accumulations of smoke and dust. One of the most successful of these polychromatic works was the Albert Memorial in Hyde Park. The front of Messrs. Sotheran's shop in Piccadilly was enriched by Messrs. Ernest George and Peto, with figure subjects in opaque glass, and the St. James's Restaurant, close by, had mosaics on a gold ground.

Some of Messrs. Doulton's buildings were ornamented with glazed stoneware and jewels, and the name of the firm was displayed on panels of enameled ware enriched with a pattern in colors. A new railway station in the Finchley road was enriched with stoneware and jewels, and its passages and platforms were lined with white and gray bricks in bands. Lately two warehouses had been built in the City, in which free use was made of glazed bricks. That in Knightrider street was wholly of this material and iron, the piers being of greenish white glazed bricks with gray bands and plinths of dark brown. The walls above were white, with gray bands; and the architraves of windows, string courses, and cornices were of brown enameled bricks, with impressed patterns; the shield and corbel sustaining the angle on the first floor over the rounded corner beneath of the same color; and joining the upper and lower windows were bands of gray glazed bricks, with the edges moulded, paneled with brown glazed patterned bricks.

The architect of another new warehouse in Moorfields had not so frankly accepted the glazed ware. Yellow and red terra cotta, Victoria and Portland stone, and blue Staffordshire bricks were used in conjunction with dark red glazed bricks and tiles, large glazed ornaments of a rich brown color, and white and gray glazed bricks. Time alone would show how these different materials would work together. Even now the yellow terra cotta cornice of the ground floor was getting black. Both of these warehouses were rather prepossessing examples of polychromy in broad flat tints; and he might also refer to a successful piece of partial polychromy in a warehouse at Lisson Grove, and to the glazed earthenware in white and yellow to be seen outside the South Kensington Museum.

As regarded painting he would allude to two notable examples; a shop in Berners street, and a house by North gate, Regent's Park. The pilasters of the former were red, ornamented in gold with gilt capitals, with colored panels between, and the heads of musicians on a gold ground in imitation of mosaic. The other house was that of Mr. Tadema. The front was treated mainly in yellow and white, with yellow columns to the porch, and a light colored Greek ornament on the dark blue back ground of its frieze. At the back two blank arched spaces had been treated by white and red lines, and small colored forms on a dark ground. The blank arches had small windows at the top, whose splays and heads had been left white, with ornaments in the shape of colored lines and jewels.

We could but regret that from our wretched leasehold tenures so little good work was done in London, and when it was done it was mostly in perishable materials. Had these houses been the proprietors' freehold, the work would probably have been executed in permanent materials, and would have been a delight and an honor to London. It was too painful, too disgusting, to think of these works perishing, not only for the loss of the skill and labor employed on them, but as the extinction of personal memorials of artists —artists who had been pioneers in the right way. It was like the story of the idiot who invited a great sculptor to carve a statue in snow. He would not omit the purple red houses we saw on every side, which, though not altogether to be approved of, might, perhaps, be welcomed as a protest against universal drab. He might mention the sgraffito work at the South Kensington Museum; a house by the Albert Hall; others near the river and elsewhere, as well as such specimens of polychromy by colored stories, such as in an office on the City side of Blackfriars' Bridge; but all rough materials so soon got blackened in London, that it was almost waste of time to use them.

The question before us was, how could we redeem our buildings from their hideous monotony, looking as they did, in misty weather and in twilight, like ghastly white or gray specters? In England generally it was not very easy to get the permanent color wanted, on account of the damp, for even in the country all powdered materials afforded a footing for moss and lichens, and red roofs soon became green, yellow, or gray, and stone itself was draped with lichens. It was in London and the large manufacturing towns, however, that our greatest difficulty arose, as any partial coloring in glazed materials, in combination with rough and porous ones, soon got out of tone, the glazed work standing out from its blackened surfaces like the teeth in a grinning negro.

From the traffic there must be some dust, from artificial heat some smoke and some pernicious gases; but we suffered mainly from the folly, indolence, and perverse ingenuity of man. His folly was shown in not paving the streets with asphalt; his indolence in not even keeping them clean; his perverse ingenuity in using coal so that a large part was unburnt; the air was thus filled with soot, which choked the lungs and skin, and covered his trees and buildings with a black pall. It was useless to speak of the carbonic, sulphuric, and nitric acid with which this truly infernal atmosphere was charged. No marble used outside would withstand our climate. Red and green porphyry and some of the granites were the only natural materials that were permanent. Bronze stood pretty well; glass mosaic, glazed stoneware, and earthenware were practically imperishable. The white tiles so largely used outside soon perish, and he had been told by an expert (Mr. De Morgan) that this resulted because the tiles were of porcelain, which slowly absorbed moisture, but would not readily part with it, owing to the minuteness of the capillary tubes, and hence they were burst by the frost. Brown, pink, and gray polished granites, even in conjunction with the porphyries and bronze, constituted but a somber building, and were also imperial materials that only a nation, a town, or a very wealthy man could afford. Glass mosaic was also very costly, and he might remark that a gold ground on a dark setting was too light and cold, and should be more copper colored.

If the buildings in London and in our large manufacturing towns were to be made clean, gay, and beautiful, we must rely solely on enameled brick. What a field this afforded for design in color, in ornament, in landscape, and in figures. It would be a healthy material, for it would lighten our streets and keep them clearer, and it would be cheap, for the tenants would only have to wash the fronts of their houses, instead of painting them. Mr. Aitchison concluded by quoting an objection and its answer in the words of M. Sedille: "If an objection be raised that this ornamental glazed ware so widely spread may increase the number of bad examples, I answer that there are, too, good and bad books, yet no one is inclined to deny the utility of printing. It will belong to our brother architects to create good examples, or, at least, to choose them."

A CENTRIFUGAL pumping engine capable of pumping two and a half million gallons of water from the Missouri River into two large settling reservoirs is constructing for Council Bluffs, Iowa.

THOROUGH WASHING AND EFFECTUAL FIXATION OF GELATINE NEGATIVES.

FEW have a just idea of the difficulties which accompany complete removal of all traces of soluble matter from a gelatine film; especially when the considerable hardening influences which ordinarily accompany exposure and development have rendered the gelatine more or less impervious to aqueous fluids.

The first point to be considered is the removal of the haloid salts of silver from the developed negative, the solvent being in all ordinary cases a strong solution of sodium hyposulphite. As a chemical exercise it may be interesting and instructive to calculate how much silver bromide, chloride, or iodide a given weight of sodium hyposulphite will render soluble; but from a practical point of view such calculations have but little value, and they are likely to divert the attention of photographers from the urgent necessity of making use of such a considerable excess of hyposulphite as shall amount to several hundred times the quantity which is theoretically necessary for dissolving the silver salts.

Those who have been accustomed to wet plate work, and have experienced the case with which a collodion film yields up its silver bromide and iodide to the fixing solution, are especially liable to underestimate the considerable time required to fix a gelatine negative. The wet collodion film is of the nature of an open network, comparable to a sponge; this structure being apparent at once when a microscopical examination is made. The gelatine film is, on the other hand, quite free from anything approaching a cellular structure, and when a section is magnified to the utmost a clean and continuous surface is presented.

Considering the importance of thoroughly removing every trace of silver which does not form an integral part of the photographic image, and the low price at which sodium hyposulphite is sold, it is advisible to carry out the late Mr. Thomas' suggestion of always using a second bath of fresh hyposulphite. Four ounces of hyposulphite to one pint of water is probably the best strength to make the bath, and not less than sufficient to cover the plate to a depth of half an inch should be used in the first instance. It is well to allow the plate to remain in this bath just double the time which is required for all traces of bromide or iodide to disappear from the sight. The old hyposulphite solution, having now been drained away, is replaced by a fresh portion; but in this case about half the quantity, or as much as will cover the plate to a depth of a quarter of an inch, will suffice; and the negative should be allowed to remain in this bath for about the same time as it remained in the first. Immediately the plate is taken from the hyposulphite solution, it should be placed in water, or the picture may be weakened or lost by virtue of the increased solvent action of the hyposulphite solution as it becomes concentrated by the partial drying of the film; and the diffusion of silver salts through the film which accompanies this reduction of the image may introduce those very evils which ordinarily accompany imperfect fixation.

Simple solution, when unaccompanied by chemical reaction, is always accompanied by the absorption of heat or the production of cold, and as a consequence, one finds that a freshly prepared solution of sodium hyposulphite is considerably colder than the atmosphere. This cold solution acts far less energetically on silver salts then when it is at a normal temperature, and not only for this reason, but for others also, it should never be used for fixing gelatino-bromide plates. If, on the other hand, the solution be warmed by artificial means, there is considerable risk of so far increasing its solvent powers as to endanger the photographic image itself. The best plan is to prepare a moderate stock of the solution, and to keep it in some locality where the temperature is tolerably constant, say between 8° and 16° Centigrade (46° and 61° Fahr.).

We pass on now to the question of washing, and unless this is done effectually, the whole work of the photographer is rendered of no avail, the negative gradually becoming weaker by the influence of light and time; while varnish refuses to hold properly to the film, and silver from the printing paper stains it.

All these circumstances are easy to understand, as any trace of hyposulphite remaining becomes concentrated and dissolves more or less of the metallic image, while the silver thus dissolved diffuses all over the film, and leads to the ultimate darkening of the transparent portions. Varnish will never satisfactorily adhere to a film containing hypo, as the salt retains moisture, and prevents a fair union between the resinous coating and the gelatine; while the same circumstance fully explains the readiness with which an imperfect washed negative becomes stained during the operation of printing.

No rule whatever can be given as to the amount of washing required; but we have generally found that soaking for ten minutes, in each one of six changes of water, is sufficient. In order that some idea may be gained as to the extent to which washing may be necessary for any particular batch of plates, it is convenient to test for hyposulphite of soda occasionally. The most convenient test is a very dilute solution of the blue iodide of starch, hyposulphites possessing the property of decolorizing this fluid.

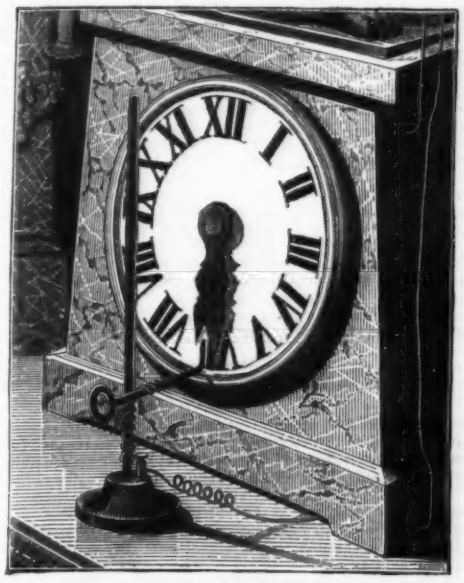
To prepare the iodide of starch solution, about twenty grains of starch are mixed with a few drops of cold water, after which a teacupful of boiling water is poured in, so as to break up the grains and form a very dilute starch paste; when this is quite cold, tincture of iodine is stirred in, not more than one drop being added at a time, until an intensely blue liquid is obtained. A little of this is next diluted, until the blue shade is *only just perceptible*, when a teaspoonful is placed in a white saucer; and if a solution containing as small a quantity as one-hundredth of a grain of hyposulphite is added to the liquid in the saucer, the blue color will disappear. To test the progress of the washing, place the plate in a level position with the film upward, and pour as much water on the film as it will retain without overflowing. After this water has remained on the film for ten minutes, it is poured off into the saucer containing about a teaspoonful of the dilute iodide of starch solution. If decolorizing takes place, hyposulphite is certainly present; but if no decolorization occurs, there is either very little or no hyposulphite present. Even in this latter case, one short additional washing should be resorted to, in order to make all safe.

When the fixing solution is used as freely as we now recommend, the economy of precipitating the silver from even the first fixing bath becomes doubtful; but the primary object of the photographer is to produce good, permanent, and reliable work; while the mere waste of the silver dissolved out in fixing, becomes a very small matter when considered in relation to the main question.—*Photo. News.*

AN ELECTRIC ALARM.

A CORRESPONDENT of *La Nature* describes, as follows, a simple morning alarm, formed of an electric bell and an ordinary clock:

One of the conducting wires is connected with any one of the metallic parts of the clock, while the other is connected with a vertical rod on which slides by friction a spiral of copper wire. This latter is bent at about its center at right angles, so as to form a horizontal arm in which may revolve another rod, one of whose extremities is bent at right angles. Things being arranged thus, the bent end of the rod may be given any position that is necessary for placing it against the clock face, and in front of a given hour, in such a way that the minute hand shall pass freely over it, while the hour hand shall come in contact with it, on arriving at the given hour, and thus establish a contact and set the electric bell ringing.

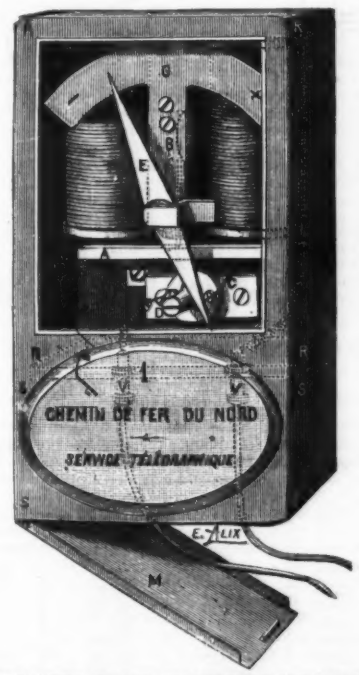


ELECTRIC MORNING ALARM.

If this little apparatus be constructed of sufficiently light material, it can in nowise interfere with the regular running of the clock, especially if care be taken to rise and remove it as soon as the alarm bell rings.

DESRUELLES'S GALVANOMETRIC TRIAL-BELL.

WORKMEN who are specially engaged in putting up electric apparatus and wires, and the engineers themselves who are charged with the supervision of operations of this nature, often have need either of verifying the presence of the electric current or of ascertaining whether the electricity is positive or negative. On another hand, in certain lines of railroads where the applications of electricity are numerous, such a need is still more felt by reason of the long distances that the special agents have to go in order to keep the apparatus in repair, and to find what is out of order therein.



DESRUELLES'S GALVANOMETRIC TRIAL-BELL.

Mr. Desruelles, a Parisian manufacturer, has recently constructed, from directions given by an engineer connected with the telegraph service on the Railway of the North, a small galvanometric trial-bell, which is capable of rendering, from this point of view, genuine service.

This apparatus, which is shown in the annexed figure, consists of an oblong box of nickel-plated copper, divided into two compartments, and containing a vibrating hammer and a compass.

In the first compartment, R R R R, there is arranged an electro-magnet whose resistance is equal to that of one Leclanche (porous-vessel) element. In front of the poles of this magnet is placed an amature, A, and to the center of the latter is fixed a hammer, B, which strikes against the end of the box. The amature is held at each extremity by two very elastic springs in the form of a square. The contact spring, C, which effects the interruptions of the current, is connected with a small rod, D, whose position may be varied so as to render the bell more or less sensitive.

The apparatus is also provided with a small magnetic needle, E, which is mounted on a pivot, and, under the influence of the current acting upon the electro-magnet, moves toward the signs — or + that are engraved on the anchor shaped dial, G. This first compartment is closed by a thick piece of glass which permits the entire operation of the apparatus to be seen during the trials.

In the second compartment, S S S S, are arranged two flexible wires covered with cotton of different colors, and each about 0·40 m. in length. To one of their extremities is soldered a metallic plug, which enters by hard friction the cylinders, V¹ to which are attached the two wires of the electro-magnet. This compartment is likewise provided at its lower part with a cover, B, for protecting the flexible wires from damage.

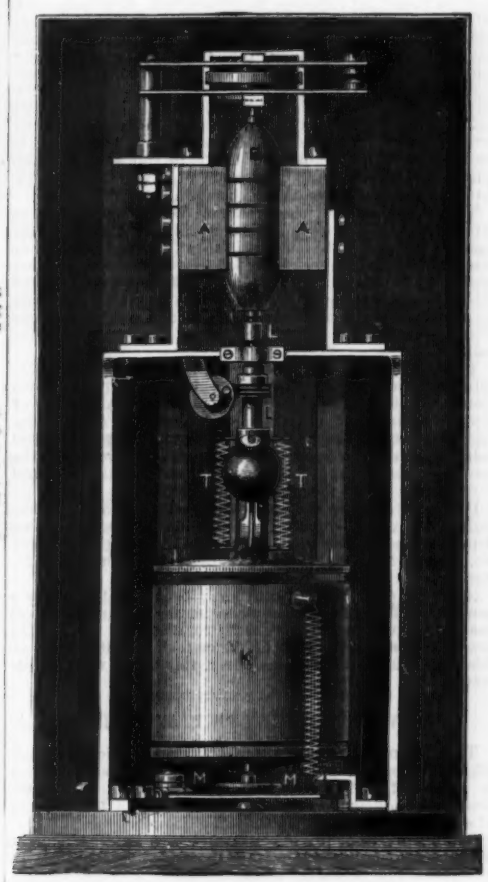
The entire apparatus has the form and dimensions of a small match-box. It can be easily carried in the pocket, and, as it is hermetically closed, it is not capable of getting out of order.

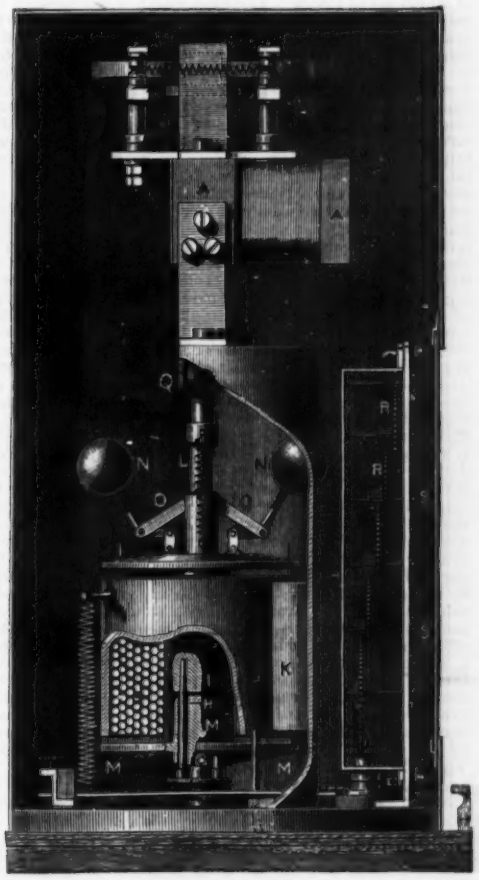
At the moment of making a trial, it is only necessary to open the lid of the lower compartment and to take out the two wires and put them in communication with the pile or apparatus to be verified. The strength with which the hammer vibrates against the box denotes the state of the apparatus submitted to trial, and the needle gives the direction of the current.—*La Lumière Electrique.*

HOPKINSON'S CURRENT METER.

THE question of measuring the electric supply to a house or factory is becoming of serious importance, as may be gathered from the animated discussion which took place after the reading of Mr. Shoolbred's paper on the subject at the recent meeting of the Society of Telegraph Engineers and Electricians. Electric meters may be divided into two classes: (1) Quantity or Coulomb meters, and (2) energy or work meters. The first class is that which is in favor with the public, who regard the electric current much in the same way as they regard water supply, and do not understand that the proper analogy to it is *water under pressure*, not simply water in quantity. As Professor Perry pointed out at the meeting referred to, the energy or erg meter is really the proper instrument to use, since it is electric energy which is supplied; and if, as appears likely, the current is made to perform mechanical work in addition to lighting a building, the necessity for an energy or work meter becomes still more obvious. In New York the Edison system is at work in a large district, and it is stated that the chief revenue of the supplying company is for electric power delivered to machines by day. The light in fact given at night is regarded as a "waste product," just as coke, ammonia, and tar are regarded by the gas companies. On the whole, then, it appears that for the manufacturers' sake it would be best if energy meters were adopted in preference to Coulomb or quantity meters. But according to Mr. R. T. Crompton, this is unlikely to happen, as the Board of Trade have evidently made up their minds to have current meters.

The current meters of Edison and Sprague are based on electrolytic action, that is to say, the deposition of zinc or copper by the passage of a portion of the current through an electrolytic cell. The portion of current thus employed bears a constant ratio to the whole current, and hence the weight of metal deposited in a given time measures the quantity of current. In Sprague's pattern the current is periodically reversed through the cell by automatic action, and the work done is thus undone again; and the number of reversals is recorded in a given time as a measure of the current. Messrs. Ayrton and Perry, Mr. Boys, and others have devised very ingenious current meters based on electro-magnetic and mechanical effects. To this class belongs the current meter of Dr. J. Hopkinson, F.R.S., which we now illustrate, and which has many advantages in its favor.





IMPROVED METER FOR ELECTRIC CURRENTS.

Fig. 1 is a side view, with part shown in section, of the Hopkinson Coulomb or current meter, and Fig. 2 is a back view with case shown in section. In both figures *a a* are the electro-magnets of a small dynamo-electric machine to be used as a motor, *b* being its armature. This dynamo is wound with fine wire as a shunt to the current to be measured, part of which passes from L round the electro-magnets, then through the armature, and thence by brushes and wire to the insulated ring, *h* (Fig. 1). Here the circuit may be either made or broken, according as the movable piece or core, *i*, is raised or lowered. If this piece, which is a soft iron core within a solenoid, be lowered, the circuit is completed to the metal frame of the instrument through a vertical contact pin, *p*. This pin projects into a groove in the core, and forms a rubbing contact as the latter revolves.

The current to be measured passes through a solenoid of stout wire, *j*, inclosed in an iron tube, *k*, supported by the frame of the instrument. The vertical shaft, *l*, is driven by the armature of the dynamo and carries the iron core, *m m*, fixed to it. The iron core, *i*, revolves with the shaft, *l*, and can slide upon it. It is connected by links, *o o*, to the governor balls, *n n*, which therefore tend to raise it as the shaft revolves. The revolutions of the shaft are indicated by the worm and wormwheel, *q*, acting on the shaft and operating the pinions, *r r*, and hands of the counter, *s*. Springs, *t*, take the weight of the core, *i*, and are so adjusted that when no current passes through the coil, *j*, contact is broken with the insulated ring, *h*; but a very small current through this coil will make the contact and cause the electro-motor to begin to revolve. When a current passes through the coil, *j*, it causes attraction between the fixed tube, *k*, and the flanges of the moving cores, *m* and *i*, also between the cores, *m* and *i*. The magnetic force upon, *i* is vertically downward, and is proportional within certain limits to the square of the current in the coil. When the governor is revolving, the centrifugal force on the governor balls is proportional to the square of the speed of revolution, and tends to lift the core, *i*, in opposition to the magnetic force. These forces will exactly balance one another, for if the speed be too great, the circuit of the electro-moter will be broken and the speed will fall. If it be too small, the electro-moter will work and the speed will increase. The result is that the system will revolve with a velocity proportional to the current through the coil. Owing to the symmetrical arrangement of the cores, the electro-magnetic forces are balanced as far as the shaft, *l*, is concerned, and they do not tend to put any pressure upon the bearings.

The illustrations show the most improved form of the meter as constructed by Dr. Hopkinson, who has kindly furnished us with the particulars of the invention.—*Engineering.*

THE ELECTROLYTIC BALANCE OF CHEMICAL CORROSION.*

THIS paper treats of some fundamental points in silver electro-plating, and shows how a large amount of the electric power may be wasted by the use of too large a proportion of free potassic cyanide in the plating solution, or by using the liquid in a heated state.

In it is also described a method of ascertaining the degree of energy of chemical corrosion of metals in electrolytes, by means of the strength of electric current per unit of surface necessary to prevent such corrosion, the metals and liquids employed for this purpose in the present research being silver, and solutions of argento cyanide of potassium

* Abstract of a paper by G. Gore, LL.D., F.R.S., read before the Birmingham Philosophical Society.

containing free potassic cyanide. Numerous examples, chiefly in the form of tables, are given of the strength of current required to enter cathodes of a given amount of surface, in order to exactly balance the chemical corrosive effect upon them at atmospheric temperatures, and at higher ones, of solutions of potassic cyanide of various degrees of strength.

The method employed was to take a given solution of cyanide of potassium, pass through it, by means of a sheet of platinum anode and a burnished sheet of silver cathode, a weak electric current, and add gradually to the liquid (with stirring) small portions of argento potassic cyanide, until the faintest perceptible deposit of silver occurred. The verge of deposition thus attained was called "the balance point"; and the conditions which determine and influence it constitute the subject of this research.

The effect of various conditions upon the point of balance of electric and chemical energy were investigated, and the experiments are described. The influences examined were: Composition of the liquid, strength of current, size of cathode and density of current, electromotive force, temperature, ordinary chemical corrosion, nature of the cathode, etc. The circumstances were also investigated which affect the measurement of the current by the method employed in this research, viz., by depositing silver from a solution of argento potassic cyanide; and the sources of error (and their limit) in that method are pointed out. The effect of varying the proportions of free potassic cyanide, and of argento potassic cyanide, upon the strength of current at the balance point, are shown in tables of results. The strengths of current just sufficient to prevent all corrosion, and to deposit the whole of the silver from a solution of argento potassic cyanide of given composition, and containing free cyanide, are also shown. The influence of varying the proportions both of argento potassic cyanide and free cyanide of potassium upon the transfer resistance of the solution, and thereby upon the balance points, is also investigated and the results described.

A number of results and conclusions were arrived at, some of which are as follows: Variation, either of the number of battery elements, the proportion of water, of free potassic cyanide, or of argento potassic cyanide, destroys the balance. The effect of altering the proportion of water is opposite with strong solutions to what it is with weak ones. The electric current at the point of balance appears to be entirely conveyed by the free potassic cyanide, and does not divide itself between the two salts until the liquid contains a certain proportion of argentic salt. In strong solutions of potassic cyanide, decreasing the number of battery cells necessitates more cyanide of silver to restore the balance. The alteration of the point of balance by alteration of proportion of free potassic cyanide cannot be much accounted for by alteration of corrosive power of the liquid. A current from ten Smee's elements is about sufficiently strong to prevent all corrosion of silver at 60 degrees F. in a solution of cyanide of potassium containing a mere trace of argento potassic cyanide. The addition of nitrate, chloride, iodide, or sulphate of potassium to the cyanide solution has but little effect upon the balance point. Variation of strength and of "density" of current affect greatly the point of balance. Greater "density" irrespective of strength of current usually increases the amount of silver deposited. Difference of electromotive force of current had no conspicuous effect in altering the balance point. Rise of temperature of the liquid acts in two opposite ways: it increases the corrosive action, and by diminishing conduction-resistance it increases the current; and as the latter effect is usually a little stronger than the former one, rise of temperature alters slightly the point of balance, and enables the current to produce a sparing deposit of silver. The ordinary chemical corrosion of silver in a solution of potassic cyanide without an electric current is increased slightly by partial immersion (through capillary corrosion), and greatly by rise of temperature; it is also slightly greater in a weak solution than in a strong one, with solutions of a certain range of strength; and it is distinctly increased by contact with platinum. In consequence of the latter circumstance, a platinum cathode requires a somewhat stronger current than a silver one to enable the point of balance to be attained. In a mixed solution of potassic and argento potassic cyanides, even the smallest proportion of the former salt conveys a portion of the current, and if the cathode is large or the current is sufficiently weak, the whole of it is conveyed by that salt, however much of the double salt is present. An error is thereby introduced when deposition of silver in such a liquid is used as a measure of current. But with a large amount of the double salt, a small amount of potassic cyanide, and a current sufficiently strong, the proportionate amount of error is small. During the act of deposition the cathode surface is not at all corroded, and any deficiency in the weight of deposit is not due to corrosion, but to a portion of the current being conveyed by other ingredients of the liquid than the argentic salt. A current which produces deposition of silver prevents all corrosion of a silver cathode in the same liquid. The addition of free potassic cyanide to a solution of the double cyanide alters both the resistance and the balance point. The quantity of current diverted from the argentic salt in solution is directly proportional to the amount of free potassic cyanide present, but not always in the same ratio. The presence of a large proportion of free cyanide, together with the employment of a feeble current, conduces to the passage of a large amount of current through the liquid without depositing silver; and a current of 0·001057 ampere (which would deposit 0·132 grain of silver in two hours) was hardly strong enough to prevent all corrosion, or to deposit any silver from a solution composed of 37·5 grains of argento potassic cyanide and 112·5 grains of free cyanide of potassium in three ounces of water. While also a current, if sufficiently weak, may traverse a solution of potassic cyanide containing double cyanide without any of the current decomposing the latter, it cannot traverse a solution of double salt containing free potassic cyanide without some of it traversing the cyanide of potassium. With a very dense current also, a portion of it enters the cathode without depositing silver, and evolves gas.

It requires a much stronger current to balance the corrosion in a hot solution of the two cyanides than in a cold one, and in an instance given, a rise of temperature from 60 to 120 degrees F. was attended by the passage of 21 per cent. increase of current without deposition of silver. Addition of free potassic cyanide to a weak solution of the double salt, *at the balance point*, first decreases and then increases the current by altering the transfer resistance, probably at the cathode. An amount of current equal to 0·14857 ampere, entering a surface of ½ of a square inch, was found to be sufficiently strong to deposit nearly the whole of the silver from a solution at 60 degree F. composed of 70·11 grains of free potassic cyanide, 0·0297 grain of double cyanide, and three ounces of water, the liquid retaining dissolved a little less than that amount of silver at its balance point under those conditions. The strength of current *at the balance point* in a weak solution of potassic cyanide varies inversely as the amount of silver salt added, and at about eight times the rate. A certain strength of current must enter a given surface of silver in a given liquid under stated conditions in order to prevent all corrosion and produce deposition. The addition of the double cyanide reduces the amount of current conveyed by the free potassic cyanide into the cathode *at the balance point*. Successive additions of double salt to a solution of potassic cyanide *not at the balance point*, first decrease and then increase the current by altering the transfer resistance; it alters the relation of the molecules of potassic cyanide to the cathode so as to diminish their power of transmitting current into that surface without depositing silver. The greater the proportion of double salt present the greater the tendency to the deposition of silver. Addition of potassic cyanide to a weak solution of the double salt *not at the balance point*, first decreases and then increases the current by altering the transfer resistance at the cathode; in this respect it behaves like addition of the double salt to a weak solution of potassic cyanide. With cathodes of platinum, a solution of potassic cyanide offered less resistance to the current (*not at the balance point*) than one of the double cyanide, but with silver cathodes the reversed effect occurred.

The balance point is a case of equalization of molecular influences, including ordinary chemical corrosion, density of current, nature of cathode, temperature, proportions of water, argento potassic cyanide, free potassic cyanide, and the soluble salts present as impurities, either of which, by being disturbed, alters all the others. All these influences also have separate numerical values. A rise of temperature of 60 degrees F. requires an increase of 0·000976 ampere to restore the equipoise. The experiments illustrate the dynamics of electro-silver plating; and the method employed in the research is applicable to the detection and measurement of molecular influence in electrolytes. In consequence of the alteration of any one of the conditions having the effect of altering all the remainder, all the above conclusions are limited in their application, and are only correct under the conditions given in the paper. The fundamental explanation underlying these conclusions is, that the phenomena are essentially molecular; and that the mere presence and admixture of the double cyanide alters the molecular arrangement of the free cyanide *not at the balance point*, in such a way as to enable the latter to transmit a greater quantity of current into a cathode of given size, notwithstanding its being more diluted by the other salt.

The phenomena of the "balance point" constitute an interesting example of molecular equilibrium, in which the balance point may be compared to a ball suspended by an elastic cord, and having attached to it a number of other similar cords, each drawing it in a different direction, and all of them being kept in a state of tension. In such a case an alteration of the degree of strain of any one of the cords changes that of all others, and alters the position of the ball.

The research has a practical bearing both upon the measurement of electric currents by means of deposition of silver from a cyanide solution, and upon the technical process of electro plating. In the former it shows how a large proportion or even the whole of a current may pass without being measured, and how the error may be reduced to the smallest amount; and in the latter, how a similar waste of current may occur, and how to prevent it.

It is manifest from the foregoing research, that the electrolytic balance of chemical corrosion of cathodes in other depositing solutions, such as those of gold, copper, nickel, etc., might form an extensive subject of experimental investigation.

Appended note. It was constantly found that in using a non-corrodible anode, such as platinum, the amount of current passing was very much more easily regulated by varying the size of the anode than that of the cathode. With a corrodible anode, however, such as silver, this effect was not observed.

A NEW EXPERIMENT IN ELECTROLYSIS.

THE decomposition of a liquid by the electric current is effected according to certain definite laws, and among these is the one that follows: "The quantity of liquid decomposed within a definite time is proportional to the quantity of electricity which within the same time traverses it."

To demonstrate this experimental law, Pouillet had the habit of placing in the same electric circuit that united the poles of a pile, a water voltameter and a sine-tangent galvanometer. The quantity of gas developed in the voltameter was proportional to the intensity of the current measured by the galvanometer.

Faraday changed the method, and made other experiments. He took three acidulated water voltameters, A, B, C, identical and of the same resistance, and interposed them in the same electric circuit, so that the current coming from one of the poles of the pile traversed in its entirety the first voltameter, A, and then, on leaving this, separated into two currents, one of which traversed the voltameter, B, and the other, C—which latter were arranged for quantity. Finally, the current, on leaving these voltameters, concentrated itself anew into a single branch, which rejoined the other pole of the pile. The quantity of gas that developed in the first voltameter, A, was perfectly equal to the sum of the quantities of gas developed in the two other voltameters, B and C, thus showing that the same quantity of electricity always produces the same sum of chemical actions.

This method, which is also mentioned in Gordon's new treatise on electricity and magnetism, doubtless merits being preferred to the former one, since it shows us the law at a single glance, and without the need of making rheometric measurements. However, I have rendered this method simpler by using but one voltameter instead of three. I have operated as follows:

I had constructed a voltameter having three platinum electrodes, *a*, *h*, *c* (Fig. 1), in all respects identical, and arranged as follows: The electrodes, *a* and *h*, are in communication with the two binding screws, *o*, *t*, by means of conductors of the same resistance; and they are, moreover, at equal distance from the third electrode, *c*, which is in communication with the set-screw, *n*, which communicates with the positive pole of the pile. A small articulated metallic cross-piece, *d*, may, as desired, set up or break the communication between the connecting screws, *o* and *t*.

Now, then, having prepared the voltameter with water acidulated to one-twentieth, and having placed graduated test-glasses on the electrodes, *a* and *h*, I passed through it the current from a sufficiently constant electric pile composed of four Bunsen couples in tension with amalgamated zincs. These couples having been charged an hour before the experiment, I put the positive rheophore in communication with the binding screw, *n*, and the negative with the screw, *m*, that communicates with the piece, *d*, which serves as a commutator. When this latter was separated from the contact, *t*, the voltameter worked only with the electrodes, *c* and *h*, and the current, in a single flux, traversed the liquid just as in any other voltameter. When the circuit had thus been closed for a certain definite time, as, for example, for five minutes, I measured the quantity of hydrogen developed in the test-glass corresponding to the electrode, *h*. In a second trial, I set up a communication between, *o* and *t* (Fig. 2), and caused the current to pass for the same length of time as in the first. This time the current divided at the electrode, *c*, into two equal fluxes, one of which passed from *c* to *a*, and the other from *c* to *h*. On measuring the quantities of hydrogen collected in the test-glasses inverted over the electrodes, *a* and *h*, which were found to be equal, I ascertained that the sum of these quantities was constantly equal to the quantity of hydrogen collected in the first experiment, thus well demonstrating the law. I ought to have employed a double positive electrode, but, since in arranging the experiment as before I obtained the same result, I preferred to render the apparatus simpler. I preferred likewise to establish the communications, as I have already said, so as to collect only the hydrogen; for the quantities of this gas gathered always correspond to the quantities developed; while sometimes this is not verified for the oxygen.

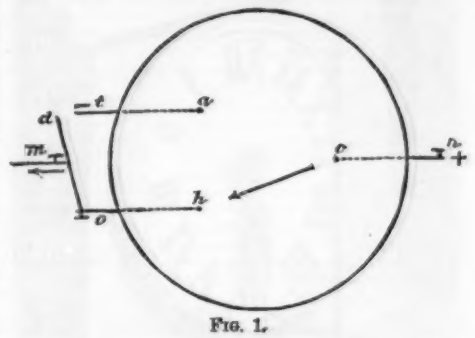


FIG. 1.

I should also observe that if, by accident, the resistances of the conductors from *t* to *a*, and from *o* to *h*, are not perfectly equal, or, again, if the set-screws, *o* and *t*, do not secure equally well the contacts in connection with the double negative electrode, the quantities of hydrogen collected in the two test-glasses will not be entirely equal to each other; but their sum will always be equal to that which is collected on experimenting with a single negative electrode. Whence we may conclude that the same quantity of electricity always produces an equal sum of chemical action.

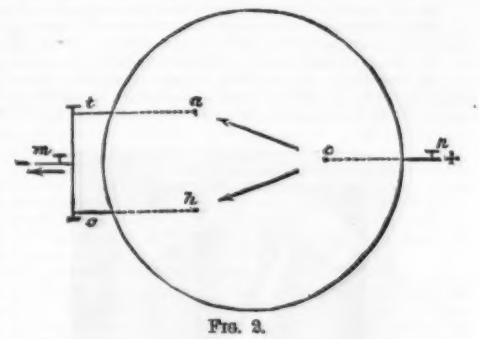


FIG. 2.

Moreover, these effects intervene equally, and in a more marked manner, on following Faraday's method; since the conductors that should be of the same resistance are more numerous, as are also the set-screws that are designed to secure contacts.—*Eugene Semmola*, in *La Lumière Electrique*.

NITRIC AND CHROMIC ACID BATTERIES.

By JOHN T. SPRAGUE.

NITRIC ACID.

THIS is a solution of the true acid (HNO_3), and varies greatly in strength. The following table shows the value of the most important strengths:

	Specific Gravity.	Percentage HNO_3.	Equivalent or atoms per lb.	Atoms in 1,000 liquid grains.
1	1·5210	100·	111·11	21·4
2	1·4518	77·777	86·42	17·90
3	1·4200	70·000	77·78	15·78
4	1·4000	66·	73·	14·49
5	1·3945	64·156	71·28	14·19
6	1·3732	60·437	67·15	13·17
7	1·2462	39·063	43·46	7·70
8	1·2402	38·121	42·36	7·51

1 is the theoretical acid, formerly called the first hydrate.
2 is $2HNO_3 + 2H_2O$, formerly called the second hydrate.
3 is $2HNO_3 + 3H_2O$. This distills unchanged at 248° F., and is the strength to which boiling brings both stronger and weaker acids.
4 is an ordinary commercial strength.
6 is double aqua fortis.
8 is simple aqua fortis.

An impure fuming acid is obtainable, which cannot be valued by specific gravity, as it contains sulphuric acid and other substances but serves very well for battery use. The best test for acid for this purpose is a small Grove cell, into which a measured quantity can be placed, so that the current it generates on a known galvanometer, and the time it will maintain it, can be observed.

The reaction which occurs is very complicated, and varies at different stages of the action. HNO_3 may lose one atom of oxygen, becoming HNO_2 nitrous acid, under two units of action which provide H_2 to form H_2O water; but one atom of hydrogen is equally able to take up one of oxygen together with the hydrogen of the acid; thus $HNO_3 + H_2$ becomes $H_2O + NO_2$, or, the same reaction taking place with the residue (nitrous acid) of the first case, $HNO_2 + H_2$ becomes $H_2O + NO$. Part of the acid is even totally deoxidized and converted into ammonia, which unites with the acid, and may then be reduced to nitrite. In each of these cases the work done electrically by one atom of acid would be different; and for this reason the electro-motive force falls off as the action proceeds. When cells are used for producing large currents, the reaction which occurs is confined to the giving up of one equivalent of oxygen to one of hydrogen; this reaction, which must be considered the normal one to which the EMF of 1·8 volts corresponds, continues as long as the strength of the acid is over specific gravity 1·36, but from that point the EMF lowers, and on the other hand more economical reactions take place. It is evident, then, that the action ought to be considered from these distinct points of view.

When the battery is working for great force and current, the acid should not be reduced below specific gravity 1·246, line 7 of the table, and, therefore, the working power of the acid is really 73 — 43=30 units, leaving nearly two-thirds as much behind unused, besides whatever oxygen might be utilized beyond the first equivalent.

This acid is therefore available for further use, for purposes in which so great EMF and such steady constancy are not necessary; it might then be reduced to specific gravity 1·16, at which strength it would still retain about 23 per cent. of acid; but the reactions would have given 3 equivalents of oxygen in place of 1, and, therefore, the work of the pound of acid would be 73 — 23=50 × 3=150 units.

Besides the consumption of material needed for the current, there is a waste by endosmotic actions of from 6 to 10 per cent.

It is usual to employ sulphuric acid to act on the zinc; but it is well known that hydrochloric acid gives at least 5 per cent. higher electro-motive force—that is, the EMF would be over 2 volts with HCl as against 1·8 with H_2SO_4; besides which the chloride of zinc formed is very soluble, and will not creep up the cells and crystallize as the sulphate does. In fact, that sulphuric acid is generally used is owing to habit, to the hydrochloric acid being about double the price, though only a trifling part of the total cost, and chiefly, perhaps, to the fact that it gives off fumes; this latter is a legitimate objection in most batteries, but is of no moment in presence of the more objectionable nitrous fumes.

But the employment of hydrochloric acid brings about another result, viz., the use of a mixture of nitric and hydrochloric acid in such a manner as to utilize chlorine as the active agent in place of oxygen, and thus regenerate the acid.

I believe the actual use of aqua regia and hydrochloric acid is due to M. D'Arsonval, as the result of a series of valuable experiments on the working of batteries; but, of course, it has long been known that chlorine and the various similar substances which will unite with nascent hydrogen are available in the battery. M. D'Arsonval recommends an *aqua regia* composed of equal volumes of nitric and hydrochloric acids, with a volume of water equal to the acids, but the nitric acid be means is one of specific gravity 1·33. The object of the dilution is to prevent the forming of nitrous fumes, but it is obvious that the EMF must be lower. There is also an advantage in using water containing 1 in 20 of its bulk of H_2SO_4, instead of simple water. Chloride of zinc may be used in the zinc cell, or, as the acids will pass through the porous cell, it is only necessary to occasionally replace part of its contents with water.

CHROMIC ACID.

Batteries in which bichromate of potash is used act really by the chromic acid which is set free by the action of another acid, usually sulphuric. Bichromate of potash is not a true twofold acid salt like bisulphate of potash, but consists of one atom of chromate of potash and one of chromic anhydride ($K_2CrO_4CrO_3$). Its formula is generally written as K_2O2CrO_3, or $K_2Cr_2O_7$, making its atomic weight on the new notation 295·2. Four atoms of sulphuric acid (98×4=392) unite with this, and the result of the reaction, when effected in a battery and completed, is the production of chrome alum and 3 atoms of oxygen, the abstraction of which, by the nascent hydrogen set free by the reaction of 3 more atoms of acid upon zinc, is the cause of the action, considered apart from the preliminary action of the sulphuric acid on the salt itself, which does not affect the ultimate result. Thus, omitting the extra water required for the alum, the reaction may be expressed as

$$\left.\begin{matrix} K_2CrO_4 \\ CrO_3 \end{matrix}\right\} + 4H_2SO_4 = \left\{\begin{matrix} K_2SO_4 \\ Cr_2(SO_4)_3 \end{matrix}\right. + 4H_2O$$
$$3Zn + 3H_2SO_4 = 3ZnSO_4 + 6H \Big\} 3H_2O.$$

That is to say, 1 atom of bichromate of potash with 4 of sulphuric acid gives oxygen equivalent to the hydrogen derived from 3 atoms of zinc acting on 3 of sulphuric acid. This is equal to 6 units of current, and makes the electric equivalent of the potash salt under these conditions about 50 grains, which quantity requires 66 by weight, or 38 by measure, of sulphuric acid to effect its own decomposition. If the acid to act in the zinc is to be provided in the same solution, an additional equivalent is needed, making the quantity of each unit for work 115 grains by weight, or 66 by measure.

Owing to the insolubility of the salt, the solution is weak, a pint being only about 25 units, therefore a large porous cell must be used, unless the zinc is placed within. The usual directions for preparing the solution are to dissolve 3 ounces of the salt in a pint of water by aid of heat, and when cool add one-twelfth its bulk, or 2 ounces of sulphuric acid; but this is erroneous; it only supplies the first four equivalents of acid, and though given for single cell bichromates, is only suitable for a double cell, in which acid is used besides to dissolve the zinc. In order to utilize the salt completely, a nearly equal quantity of acid should be added, when the action becomes sluggish; if added at first, it causes too great local action, and this is always very great.

The electro-motive force falls rapidly, and the resistance increases with this solution, as the chromic alum forms; this also frequently crystallizes in the solution and upon the carbon.

Hydrochloric Acid used instead of sulphuric avoids many of these defects. The solution can be prepared with equal volumes of the cold saturated solution of bichromate of potash and of hydrochloric acid. The combinations of chromium are so complicated, and so easily modified by conditions of temperature and saturation, that it is difficult to say what actually occurs; but the following expressions appear most probable:

$$\left.\begin{matrix} K_2CrO_4 \\ CrO_3 \end{matrix}\right\} \begin{matrix} +2HCl \\ +2HCl \end{matrix} \Big\} = 2KCl + H_2CrO_4 + H_2CrO_3Cl_2$$

That is to say, 1 molecule (or atom) of bichromate of potash, 295, with 4 atoms of hydrochloric acid is resolved into 2 of potassium chloride (which then passes out of consideration), 1 of chromic acid, and 1 of a chloro-chromic acid, in which Cl_2 replaces 1 atom of oxygen. These two acids now react upon the hydrogen derived from the action of zinc upon the acid, thus:

$$H_2CrO_4 + 2HCl + 4H = CrCl_3 + 4H_2O$$
$$H_2CrO_3Cl_2 + \quad + 4H = CrCl_3 + 3H_2O$$
$$4Zn + 8HCl + \quad = 4ZnCl_2$$

Hence, 1 molecule (296) of the salt with 6 atoms HCl is equal to the production of 8 units of current, requiring a further 8 atoms (14 in all) of acid to dissolve the 4 atoms or 8 equivalents of zinc. In this case, therefore, the equivalent of the salt is only 37·5, because it is wholly reduced to neutral chloride instead of to sesqui-sulphate, as in the other case; each unit, therefore, requires 1 unit of acid for its own reaction, and 1 unit either in the same or a separate cell for the zinc. No crystals form in this solution.

Chromate of Calcium would be very useful if it could be obtained in the market, especially as its residues are easily converted into valuable colors. I have been applied to frequently about this salt, and, therefore, I may say that, although actually produced in the process of making the potash salt, it is not prepared for the market, owing to there being no large demand; it ought to be considerably cheaper than bichromate of potash. It can be prepared by those who wish it for use by dissolving 5 parts of bichromate of potash in boiling water, and adding one part quicklime (just slaked before use) and 2½ parts of plaster of Paris. It will come down as a yellow powder, which contains an atom of water, and has an equivalent of about 60 grains per unit, and requires one-fifth more acid than the potash salt. One-half the lime is thrown down as sulphate on the addition of the acid, and the rest precipitates during the action.

Voisin's Red Salt is very convenient for amateurs who do not wish to have the trouble of acids; it is a compound salt containing the necessary acid in the proportion of the formula. It gives the same EMF as the ordinary solution, and appears to be rather more constant, but produces a somewhat greater resistance. It should be dissolved 20 to 25 parts to the 100 of water. That is, 4 oz. to 5 oz. in a pint. It consists of

$$\underset{140}{Na_2SO_4} + \underset{686}{7H_2SO_4} + \underset{295}{K_2Cr_2O_7}$$

which is probably changed by the action into

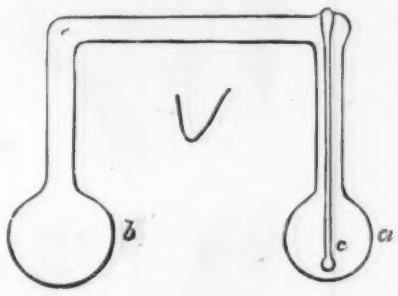
$$2NaHSO_4 + 2KHSO_4 + 2CrO_2(2SO_3) + 7 \text{ water.}$$

It is made by dissolving the sulphate of soda in the heated acid and gradually stirring in the bichromate; it is then poured into moulds, and, after cooling, removed and broken up.—*English Mechanic.*

[CHEMICAL NEWS.]

ICE UNDER LOW PRESSURES.

THE exhibition of the infusibility of ice under low pressures has up to the present time been a somewhat troublesome matter, the amount of time spent in getting the apparatus in order being generally very great. The following method of showing the experiment is simple and works very well, and the apparatus once prepared is always ready for use. The



instrument is an ordinary Wollaston's cryophorus with a glass tube or rod fused into one angle of the glass tube, and terminating in a knob, *c*, rather below the center of the bulb. The apparatus is exhausted by boiling water in both bulbs until the right amount is left, and then sealing up.

The water is allowed to flow into the bulb, *a*, in which the rod is fixed, and the other bulb is placed in a freezing mixture. When the water in *a* is frozen to a sufficient depth, it is placed for a few moments in warm water, so as to melt the ice in contact with the glass. The water formed is poured quickly into the bulb, *b*, which is at once replaced in the freezing mixture. By carefully heating the bulb, *a*, the whole of the ice in contact with the bulb may be melted and removed, leaving a free block of ice attached to the knob. The bulb may then be placed in a beaker of boiling water, sulphuric acid, or oil, and so long as *b* remains in the freezing mixture the ice will not melt.

At a meeting of the Owens College Chemical Society, when the apparatus was exhibited the bulb, *a*, remained in boiling water for about an hour and a half, when the sublimation had proceeded so far that the ice became detached from the knob and fell, and then immediately melted. This is explained by the fact that when the ice comes in actual contact with the hot glass the vapor formed is not removed with sufficient rapidity to keep the pressure below what may be called the critical pressure, and thus the ice melts at once.

By placing thermometers in each bulb the relative temperatures of the ice and of the condenser may be readily ascertained, and Prof. Ramsay and I hope shortly to make some experiments to settle this point; while by a modification of the apparatus, devised by Prof. Ramsay, the latent heat of sublimation of ice may, we hope, be determined.

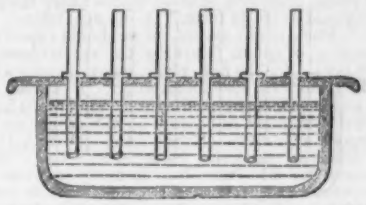
SYDNEY YOUNG.

University College, Bristol,
February, 1883.

APPARATUS FOR BOILING GOLD ASSAYS.

By W. F. LOWE.

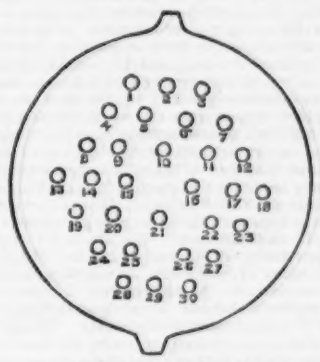
THE apparatus consists of (1) a porcelain basin (*a*) 8¼ in. in diameter, having a capacity of 50 oz.; (2) a porcelain cover (*b*) perforated with thirty holes, each hole being numbered in black enamel; and (3) of a number of glass tubes (*c*). These tubes are made to slip loosely through the holes in the cover, and in order that they may not come against the bottom of the basin the glass is bulged out into



(*a*). SECTION OF BASIN, TUBES, AND COVER. One-fourth size.

a ring, near the center of the tube, which rests upon the cover; they have two small holes, one on each side of the bottom, one in the center of the bottom, and also one in the side an inch above.

The method of employing the apparatus is the following: Two basins, containing a sufficient quantity respectively of strong and weak nitric acid, are heated over the lamp, the weak acid basin being covered with the perforated cover carrying the boiling tubes, and the strong acid being covered with an ordinary dinner plate. The assays, which can



(*b*). COVER. One-fourth size.

be flattened and rolled while the acid is being heated, are dipped into the tubes; and in about five minutes, if the acid is boiling, the whole thirty may be lifted off by the cover, washed by being dipped into a basin of water, and then transferred to the basin of strong acid, where they are boiled for half an hour or more, after which they are all lifted off by the cover, and transferred to a similar basin full of water. Each tube is taken out, and plunged over head in water so as to fill the tube, and the assay is transferred to the crucible in the same way as from a flask.

I have had this apparatus at work for more than twelve

(*c*). TUBE. One-half size.

months, and have found it a great saving of labor, besides requiring so little attention; in fact, it can be left for an hour without the assays taking any harm, and I consider it preferable to boiling in flasks, for all the assays are under exactly the same conditions, and can be boiled in the acid for a much longer time. Another recommendation is that it is of very moderate cost. For boiling the basins I use two of Fletcher's radial burners, which are very suitable, as they are little affected by the fumes.—*Chemical News.*

CONVERSION OF ALIZARINE BLUE INTO A SOLUBLE STATE.

THE Baden Aniline Company, of Ludwigshafen, mix up the commercial alizarine blue in its ordinary form of a paste (containing 10 to 12 per cent. of actual coloring matter) with 25 to 30 per cent. of a solution of bisulphite of soda at 49° Tw., and the mixture is left to soak for 8 to 15 days. It is then filtered; the blue which has not been dissolved remains upon the filter, and is used in a second operation. That which passes through the filter may be used at once for dyeing; or it may be obtained in the form of a crystalline powder by mixing it with common salt and evaporating at a low temperature. The solution is of a reddish brown, and deposits alizarine blue if treated with strong acids or alkaline carbonates. The same result is obtained by heating the soluble alizarine blue to 158° to 176° F. To this soluble blue may be added acetic or tartaric acid, and even salts of lime, without decomposition or the formation of lakes. Thus the blue may be mixed with the metallic salts and printed upon tissues. The color is afterward fixed by heating to 158° to 176° F.

ALCOHOL IN HEALTH.

By C. BARLOW, M.D., Eaton, Ill.

I NOTICE an extract from the *American Pharmacist* in the November number of the *Therapeutic Gazette*, in which the editor, in speaking of the effect of liquor prohibition laws on the opium habit, says: "A great deal of blame for this habit can very justly be referred to those who, in their desire to prevent intoxication, have introduced laws prohibiting the sale of liquors. We find from the information accumulated by the Michigan State Board of Health that the consumption of opium is greatest in those States where the strongest prohibition laws are in force." I do not believe there is any one to blame in this matter, for we should expect a greater consumption of opium following the enforcement of prohibition laws. In the first place, many persons who drink alcoholic liquors are also opium eaters. It is also a fact that nearly all who use them use tobacco. They must have some additional stimulants, and opium as well as tobacco answers the purpose admirably. Every drink of alcoholic liquor taken increases the desire for stimulants, hence we might expect any one who uses it to naturally resort to opium, tobacco, etc., as adjuncts to their more favorite stimulant. And we can readily foresee the result; when alcohol cannot be had, opium will be taken in increased quantity. So then the question is, Does liquor prohibition increase the number of opium eaters, or only increase the quantity taken by those who already use it? I presume it does both to some extent; but it has no effect upon any other class than the one that uses alcoholic liquors. And only a few of these—except those who were already addicted to the habit—would resort to opium. Those who had never used it would not be very likely to take up the habit unless they were given opium by their physician for some painful malady but the number that would contract the habit in this way would be comparatively small; and we would have quite a number left who neither use opium nor alcohol, and the latter are certainly greatly benefited by the prohibition. I do not believe that liquor prohibition has any perceptible effect on the consumption of opium except by increasing the quantity taken by those who were addicted to the habit before the enforcement of prohibitory laws. Liquor prohibition could have no effect on any except those who were habitual drinkers, and if it would free half of them from the slavery of intemperance, even though the remaining half would kill themselves with opium, then the prohibitionists would have done a righteous work. Since it is only those who were addicted to alcohol that resort to opium, we may confidently expect a corresponding decline of the habit as the generation that uses it passes away; the next generation will not have that morbid appetite for stimulants which the constant use of alcohol creates. He says: "Some powerful stimulant appears to be a necessary adjunct to man's existence." Is such the case? We think not, from the fact that a large number of the race do not use stimulants of any kind; and many of those who do use them have inherited the appetite; and we are positive that if liquor prohibition could be enforced for one or two generations, men would lose much of their desire for stimulants. We do not believe that powerful stimulants are necessary for the well being of any one, but to the contrary that they are injurious just in proportion to the quantity taken.

In the volume of Transactions of the Illinois State Medical Society for 1881, the chairman of the Committee on the Use and Abuse of Alcohol reported as follows: "Such being a few of the facts as to the hurtful effects of alcohol, I would report that it should never be used in health." Now, a report of this kind, sanctioned by that august body, would be very mischievous if alcoholic stimulants were really necessary for the well being of even a small proportion of mankind. The following certificate is given in the preface to Carpenter's prize essay on "The Use and Abuse of Alcoholic Liquors in Health and Disease":

"We, the undersigned, are of opinion:

"1. That a very large proportion of human misery, including poverty, disease, and crime, is induced by the use of alcoholic or fermented liquors as beverages.

"2. That the most perfect health is compatible with total abstinence from all such intoxicating beverages, whether in the form of ardent spirits, or as wine, beer, ale, porter, cider, etc.

"3. That persons accustomed to such drinks may with perfect safety discontinue them entirely, either at once or gradually, after a short time.

"4. That total and universal abstinence from alcoholic beverages of all sorts would greatly contribute to the health, the prosperity, the morality, and the happiness of the human race."

The above was signed by upward of 2,000 physicians of all grades, "from the court physicians and leading metropolitan surgeons, who are conversant with the wants of the upper ranks of society, to the humblest country practitioner, who is familiar with the requirements of the artisan in his workshop and the laborer in the field." From the above we do not understand that "some powerful stimulant appears to be a necessary adjunct to man's existence." We quote again from the *Pharmacist*. It says: "It is impossible to deprive a human being of his stimulant, for if you remove one, another—often worse—takes its place."

Now, it is a question whether there is a worse stimulant than alcohol. When we consider the catalogue of crimes for which it is responsible, and the immediate and remote effects upon those who use it, on the community at large, and its pernicious effects upon posterity, and the domestic misery it is capable of producing, and its deleterious effects upon society, we may doubt whether there is another article in existence which is capable of doing as much mischief as alcohol. It certainly does not find its equal in opium. Are the immediate and remote effects of opium so hurtful to those who use it, and to the community, as those of alcohol? Will it cause men to spend fortunes, abuse their families, murder their wives, and turn their children out of doors? Will it fill our jails, penitentiaries, alms-houses, and asylums, as alcohol has done? Will it cause men to commit the atrocious crimes which alcohol has caused them to commit? Will it ruin as great a number of persons as alcohol? Are its effects upon posterity as pernicious as those of alcohol? These are all questions to be considered, and if the effects of opium are more prejudicial than those of alcohol, and if it is capable of doing more mischief, and of affecting a greater number of persons, and if it has a more deleterious influence on the community, and destroys more property, and breaks up more families, creates more paupers and criminals, than alcohol, then I would say that prohibition is to blame, and that it is doing an evil work; but until I am convinced that such is the case, I conclude that prohibition is beneficial, whatever effect it may have on the opium habit. Even though it may be ten times more than we might reasonably expect, it is only productive of a very meager argument against liquor prohibition. The sale of opium should also be restricted; but if we cannot prohibit the use of both opium and alcohol, let us not bring the lesser evil as an argument against the suppression of the greater.—*The Therapeutic Gazette.*

[Continued from SUPPLEMENT No. 380, page 6069.]

MALARIA.

By JAMES H. SALISBURY, A.M., M.D.

PRIZE ESSAY OF THE ALBANY MEDICAL COLLEGE ALUMNI ASSOCIATION, FEB., 1862.

IV.

I WILL now introduce some cases where the gemiasmas were found in the urine of patients. In such positive evidence the presence of the plants in either the blood, sputa, sweat, or urine of an ague case must go to sustain our position. It is only in the old cases that the plants are found in the urine.

Case 1.—November 15, 1863, Orville Ames, private, Co. L., 3d U. S. Artillery, New York, was attacked with intermittent fever the fourth of August, at Snyder's Bluff, below Vicksburg. Paroxysms came on every other day, between 9 and 10 A.M., and were very severe, with intense pain in head and lungs. He came up the river soon after the attack and went to Seminary Hospital, Covington, Ky. Thence he was sent to the Dennison. Has had chills from the 4th of August up to present time, except during now and then a short interval of a few days when the paroxysms seemed to yield to quinine. Had been taking it and arsenic daily. Nov. 15: Found the patient pale and anæmic, yellow, hypochondriacal, spleen enlarged, skin and mucous membranes dry, renal functions partially suppressed, tongue considerably furred, appetite poor, nausea, fæces pale, plastic, and scant, bowels rather constipated, dull pains in joints and bones.

Microscopic Examination of Urine.—The urine that was passed on the morning following the paroxysm (Nov. 16) was clear, normal in color and odor; and in it were floating a number of small white flocs and scales that were scarcely large enough to be perceptible by the naked eye. These were made up of pale reddish palmellæ (plants). With these were many mucous cells. In many of these flocs were masses of from twenty-five to fifty plants, all adhering to each other. Oxalates abundant.

Case 2.—Daniel Chase, Co. C, 51st N. Y. V. I., private, was attacked about the middle of July at Snyder's Bluff, below Vicksburg. A great many were attacked about the same time. Had chills every day, coming on about 10 A.M. Had a great deal of pain in head and chest. Has had paroxysms most of the time since the attack up to to the present, except occasionally during an interval of a few days, when the paroxysms were suspended with quinine. Has been taking quinine or arsenic almost daily since the attack, and is now in a worse condition than at any time previous. Produces pain to lie long on either side. Remained in the field till the 7th of September, when he was sent to Seminary Hospital, Covington. Came to Dennison Hospital, October 3. I found the patient pale, anæmic, yellow, hypochondriacal, spleen enlarged, hepatic derangement, skin and mucous membranes dry, renal functions partially suppressed, pains in back and limbs, constricted feeling about chest, great muscular and nervous debility, tongue furred, appetite poor, indisposition to physical and mental activity, and fæces pale, plastic, scanty, and bowels rather constipated.

Microscopic Examination of Urine.—Urine clear, and normal in color and odor. It contained no sediment but had floating in it numerous small flocs of a whitish color. These were made up of palmellæ (O, P, and Q, Plate IV.). In some of the flocs was noticed a species of penicillium. The palmellæ cells were all of a pale brick dust color (Q, Plate IV.). Oxalate of lime abundant in urine.

Case 3.—Michael Torpy, age 35, private, Company G, Ninth New Hampshire V. I., was attacked on the Mississippi River, four miles below Vicksburg, July 1. When first attacked, had a paroxysm every day. Commenced generally from 10 A.M. to 2 P.M. Had severe pain and vertigo during the paroxysms. Has had all along severe pain in back and limbs. Came to Camp Dennison Hospital, September 14. Has had paroxysms almost daily since first attacked. November 15: Found the patient pale, anæmic, yellow, hypochondriacal, the skin dry, urine partially suppressed, spleen somewhat enlarged, and liver deranged in its functions. Has had chronic diarrhœa with intermittent fever. Diarrhœa nearly well. Oxaluria severe.

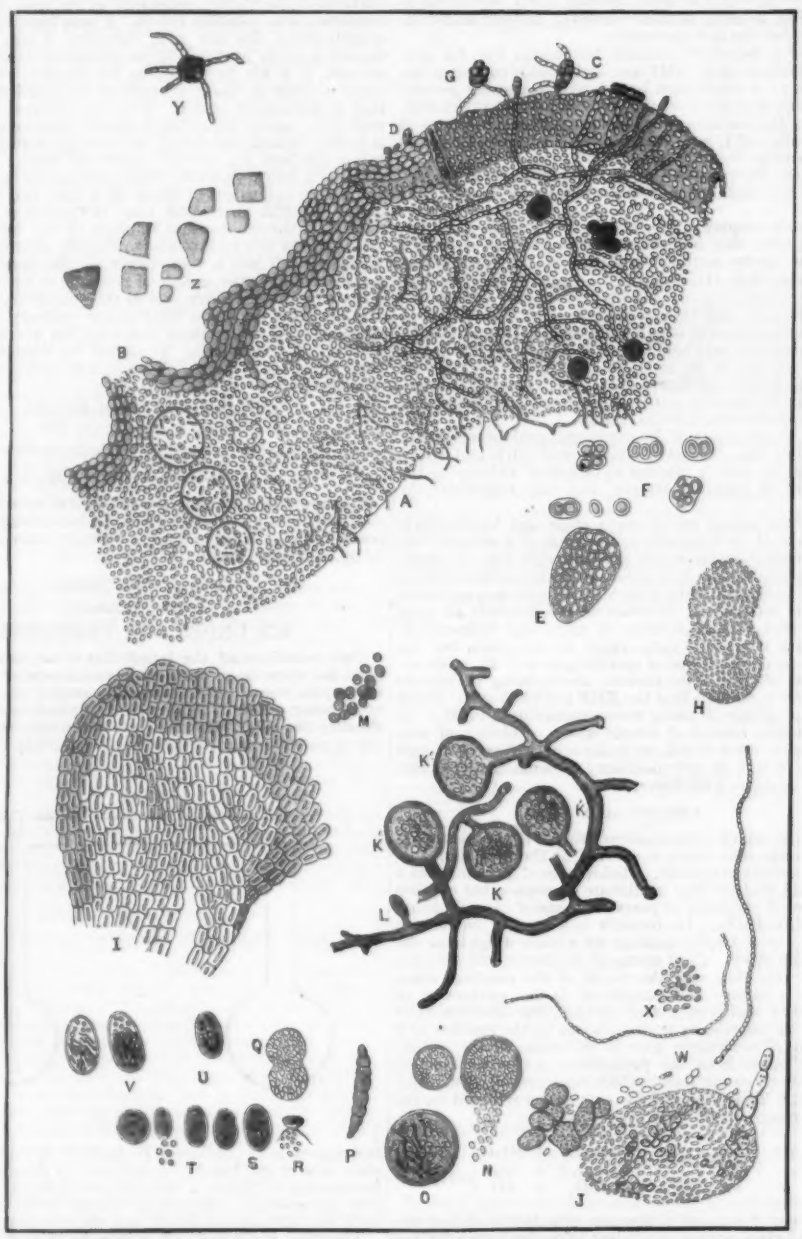


PLATE II.—A, B, C, D, Section of Protuberans gelatiformis. Near B are three sporangia *en route* for exit *via* opening at B. Toward the right smaller sporangia are seen. Ramifying through the substance are interstitial mycelial filaments of a parasitic fungus, a species of Sphærotheca. E, a small Protuberans gelatiformis. F, One mode by which E multiplies its cells. G, Parasitic fungus spore vegetating. H, Protuberans ovalis. I, Protuberans lamella. J, Protuberans ovalis throwing off spores. K, K', K', K', Filaments and spores of parasitic Sphærotheca. L, Sporangia developing from filament. M, Microspores of K highly magnified. N, O, Mature spores of Protuberans gelatiformis. P, Peculiar brownish spore case. Q, Double sporangia. R, Perithecium of I, Protuberans linearis. S, T, Sporangia of Geminsma rubra. U, V, Sporangia with red and green mixed and contents partly discharged. W, Vegetating fungus into filaments. X, Spores more highly magnified. Y, Fungus with five filaments. Z, Crystalline bodies.

PLANTS FROM THE INCRUSTATIONS OF AGUE BOGS PRODUCING MALARIAS OF A MILD TYPE.

Microscopic Examination of Urine.—Clear, and normal in color. Quantity small. Many crystals of oxalate of lime. Floating through it were numerous small flocs, which under the microscope were resolved into masses of gemiasmas of a pale brick dust color (like O and P, Plate IV.). Examination made immediately after voiding. Morning secretion.

Case 4.—William F. Caswell, private, Co. A, 11th N. H. V. I., was attacked by intermittent fever at Snyder's Bluff, below Vicksburg, June 21, 1863. Had chronic diarrhœa at this time. When first attacked had two paroxysms daily, one in the forenoon and one in the afternoon, accompanied with severe pain in head and chest. Arrival at Dennison's Hospital, August 26. Since arrival has had paroxysms nearly every other day, save occasionally at short intervals. November 15: Pale, anæmic, yellow, hypochondriacal, spleen enlarged, hepatic derangement, skin and mucous membranes dry, urine partially suppressed, pains in joints and bones, small appetite, and tongue furred.

Microscopical Examination of Urine.—Color natural. Clear, and frothed much on agitation. It contained a few floating flocs composed mostly of gemiasmas (O and P, Plate IV.). Numerous crystals of oxalate of lime.

Case 5.—John Simms, private, Co. D, 36th Ohio V. I., was attacked on the 22d of August with intermittent fever, at the barracks of Camp Dennison, Paroxysms nearly every day since. Severe pain in head during paroxysms. Dysentery for the last two weeks. November 13, nearly well.

November 15: Found him pale, yellow, anæmic, hypochondriacal, skin and mucous membrane dry, and urine partially suppressed. Spleen somewhat enlarged and some hepatic derangement.

Microscopical Examination of Urine.—Clear and natural in color. Froths like beer when shaken. Contains numerous crystals of oxalate of lime, also a few yeast cells; quite a number of small flocs of gemiasmas (O and P, Plate IV.): also an entozoon like the Anguilula aceti in size and shape.

Case 6.—Charles Derby, private, Co. A, 38th Mass. V. I., was attacked about the 1st of August with intermittent fever, on the Yazoo River. Had been there about one month before the attack. Was engaged in digging rifle pits and clearing away timber. Many were attacked about the same time. Left the Yazoo River August 5, and arrived at Dennison U. S. A. Hospital August 17. When first attacked had chills every other day. Paroxysms have continued up to the present time, with the exception of now and then a few days, when controlled temporarily by quinine. Recently, part of the time part of the time has had paroxysms daily. During the paroxysms has severe pain in head and epigastrium.

Nov. 15: Pale, anæmic, yellow, tongue furred, hypochondriacal, spleen enlarged, considerable hepatic derangement, skin dry, renal secretions scanty, stools small and plastic, bowels constipated, pains in limbs and general torpor of mind and body.

Microscopical Examination of Urine.—Clear and normal in color. Contains floating through it many small flocs composed of palmellæ (O and P, Plate IV.). With them were found a few mucous cells. Small crystals of oxalate of lime were quite numerous.

Case 7.—Charles Newell, private, Co. L, 3d U. S. Artil., R. I., was attacked with intermittent fever at Vicksburg about the 1st of August, 1863. Remained five or six days after he was attacked, and then came to Cincinnati. Had a paroxysm every day. It came on from 10 A.M. to 12 M. Had a severe pain in stomach and chest during the par-

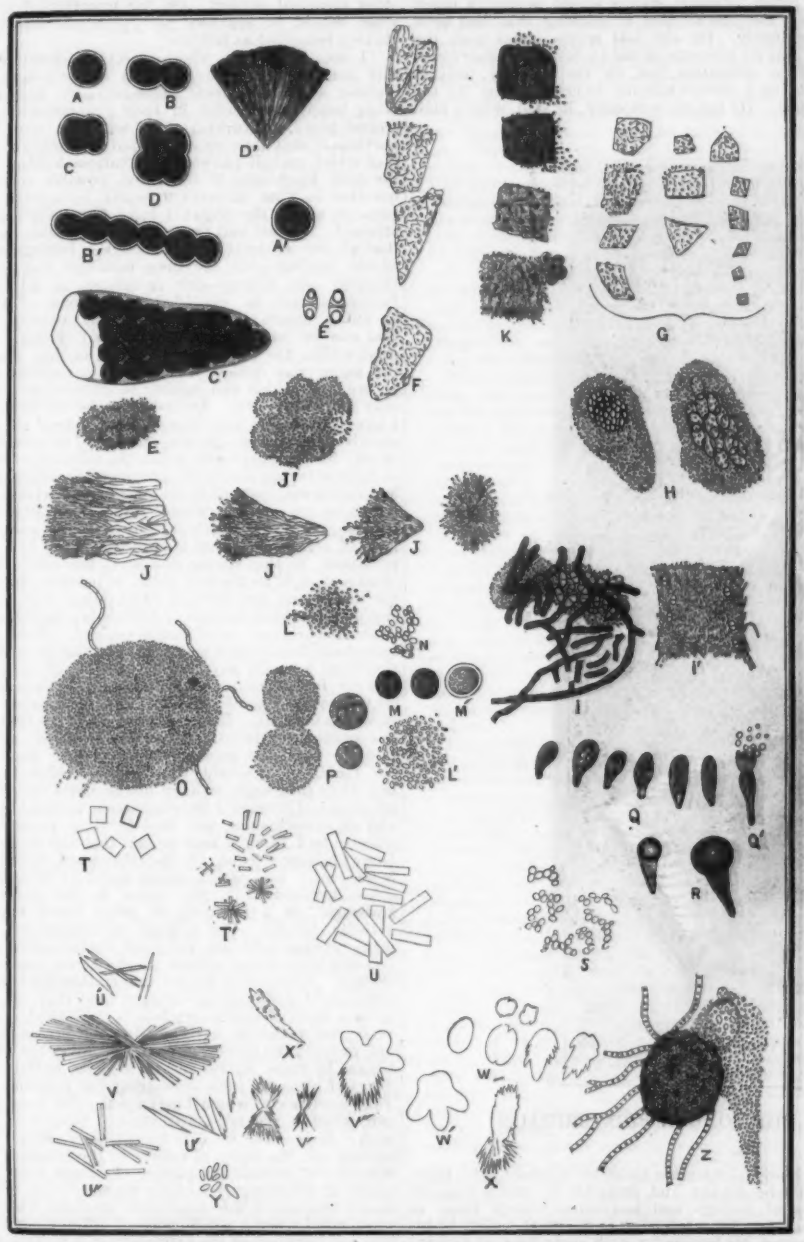


PLATE III.—A, A', The simplest form of Gemiasma rubra. B, B' show the mode in which the plants grow. C, C', D also show the mode in which the plants grow. D', Body of acicular crystals radiating from one point; also sometimes found in ague urine (see W, Q, R, Plate V). E, Mature and dry plants in the soil. E', Diatoms. F, G, Crystalline bodies. H, Same as E. I, Broken filaments of Sphærotheca. I', Peculiar growth occurring among ague plants and frequently found in the urine of malarial and typhoid cases. J, J, J, J', Like D'. K, Like D', but looking like fragments of membrane. L, L', M, M', N, O, P, *Plants in the sweat of malaria cases.* M, M', Perfect Gemiasmas. N, Torula cerevisiæ found in the sweat, blood, and urine of ague, showing presence of sugar. O, P, Larger specimens of skin plants. Q, Q', R, Asci of a species of Puccinia found abundantly in the sweat of a baker who labored under ague. S, Same as N. T, T', U, U', U'', V, V', V'', W, W', X, X', and Y are crystals and crystalline bodies separated from ague plants by ether, and occur in the plants in considerable quantity. Z, Ague plant in urine of patients suffering from malaria, with Sphærotheca filaments developing from it.

PLANTS THAT PRODUCE CONGESTIVE INTERMITTENTS.

BODIES FROM THE DRAINED AND DRIED BED OF AN OLD FISH POND SOON AFTER THE SOIL WAS SPADED UP FOR A CELERY BED.

THERAPEUTICAL REMARKS.

These seven cases on November 15 were put on the diuretic and diaphoretic treatment, which is detailed further on, with the most marked and beneficial results. They all at once began to improve; eyes became bright; the pale, sallow, anæmic condition rapidly passed away; the languor and debility and pains in limbs disappeared; appetite improved, the paroxysms were broken, and the patients in less than two weeks moved about with elastic step, renewed strength, entirely free from those debilitating influences which had been hanging over them for months.

For twenty years I have had the same experience in finding the ague palmellæ in the urine of persons suffering from the ague. The fact of the parasitic life out of its natural habitat in the urine is one that is positive and undeniable to me. It should be noticed that the native plants were found in the urine, and not merely the microspores or seeds. This shows the full development of the plants from the seeds or spores in the unnatural habitat, to wit, the urine.

MORE OBSERVATIONS.—PLANTS IN THE URINE OF AGUE.

The urine of over one hundred cases of intermittent fever has been subjected to careful microscopical examination, with the view of arriving at general results as to the abnormal bodies present. The urine was in some cases voided before treatment had been commenced, in others after treatment had been continued for some days without breaking the paroxysm, and in others the paroxysm had been broken for the time with quinine, while the fever poison still remained in the system. The urine was voided either in the algid, febrile, or sweating stage of the disease, between the paroxysms or after the paroxysms had ceased for some days. The results of the examinations are highly interesting. They establish the fact that ague plants, the same as grown upon the ague soil previously described, are constantly developing in the system of the intermittent fever patients, and that the urinary organs constitute one great and important outlet for the elimination of this fever vegetation; that the urinary organs, with the perspiratory apparatus, are the important channels through which Nature strives to rid the organism of the exciting cause, and through which the physician should operate by all the medicinal means at his disposal to eradicate the disease.

They explain to us the important reason why it is that quinine breaks the continued recurrence of the paroxysms, while it does not eradicate the poison; and why diuretics and diaphoretics and expectorants are such all-important aids in eliminating from the system the gemiasmas. While quinine braces up the system by its powerful tonic action upon the organizing processes of the epithelial tissues, and through this imparts such tonicity to the nervous system as to enable it to resist the paroxysm, it is well known not to exterminate the exciting cause; although it may control for the time its further development in the same way that it checks the multiplication of yeast plants in fermentation. This exciting cause must be carried out of the organism through those excreting channels which Nature has provided for the elimination of effete and abnormal products. The principal of these are the perspiratory apparatus, the mucous surfaces, and urinary organs. That the perspiratory apparatus performs, in this disease, an important office in this eliminating process we should long ago have understood, from the fact that through this excretory system Nature so powerfully acts in her efforts to eliminate the disease. The sweating stage of the paroxysm is essentially a curative one.

These examinations have also established the fact that in intermittent fever conditions yeast cells are constantly and uniformly present, indicating the presence of sugar in the urine. Cholesterine is also uniformly found in this excretion in ague. This points us to diabetic tendencies, as these bodies are the great abnormal products of diabetic urine. Both cholesterine and sugar are found in the spleen and liver.

The spleen is a great manufacturing organ of cholesterine, and at the same time manufactures some sugar, as is evident from the development of yeast spores in the spleen when it is removed from the body and allowed to ferment. The liver is the apparatus for organizing sugar. The kidneys never normally organize or excrete these bodies. In intermittent fever, we see, then, that the functions of the liver and spleen, of secreting sugar and cholesterine, are in part taken on by the kidneys, perhaps indicating something like a metastasis or vicariousness of function; and pointing us to these organs for disturbances that are excited by the vegetable poison of ague.

There are also found quite uniformly in the urine the spores or embryonal forms of a species of fungus, generally vegetating, belonging to the genus Sphærotheca, which is almost uniformly found growing on and in the ague plants as well as in localities where ague plants do not grow, and where ague is not known.

I do not know that the plant produces any abnormal influence upon the system, as it is often met with in the urine of healthy persons. The ague plants occur in the urine in the form of little flocs, so small that they are scarcely noticeable to the unaided eye, and too few in number to communicate turbidity to the excretion. They vary greatly in the amount present in different cases. They are uniformly more abundant when the disease is severe and has continued for some time. They appear to be developed in the bladder, and perhaps in the renal pelves and ureters, often in great numbers. In some cases of ague of long standing the yeast plant—penicillium—is also found developing in large numbers, mycelium often rising to the surface a short time after the urine is voided, and producing fertile threads and fruit. These plants were found largely developing in the urine of several patients—in the month of September—who had been laboring under the disease most of the summer. In several instances of this kind I have known the intermittent to merge after some weeks into a continued fever of a typhoid type. In all cases of this kind the patients have been receiving constant accessions to the disease by being exposed daily to the exciting cause.

[To be continued.]

CEPHALIC AUSCULTATION IN MENTAL DISEASE.

DR. ADRIANI (*Journal de Med. et de Chir. Pratiques*, February, 1883) has been conducting a series of investigations upon the transmissibility of the voice to the occiput, with a view to determine its value as a sign of mental disease. The patient should speak in a low tone while the ear of the auscultator is applied to the occiput. He thinks that the sound of the voice is transmitted by the cranial bones and not by the brain substance. The latter, however, influences the sound, and it is probably to the difference in its density that the various modifications of the voice sounds are due. According to Crichton Browne, the density of the brain varies in mental disease.

CAPTAIN EYRE MASSEY SHAW, C.B.

THE name of Captain Shaw is as familiar as "household words," and lately, indeed, his services, and those of the men of the Fire Brigade working under him, have been such that it has been impossible to take up a daily paper without seeing the name of the Chief of the Metropolitan Fire Brigade mentioned. There has been, and probably will continue to be, a great deal of discussion respecting the adequacy of the Fire Brigade to thoroughly protect the metropolis from the outbreak of fire; and though we believe Captain Shaw himself advocates an increase in men and appliances, yet by the admirable manner in which he has organized the Brigade, and the high state of discipline he has brought it into, the four hundred men under his command have proved their efficiency in every case of emergency. We have in the *Pictorial World*, on more than one occasion, referred to the work of the Brigade, but it is impossible to describe the routine of a fire station, which must be seen personally to fully comprehend the high state of efficiency of that Brigade, which keeps watch and ward over London while its inhabitants are asleep. It will be remembered that the Fire Brigade was originally supported by the insurance companies, but about fourteen years ago the Metropolitan Board of Works undertook the duty, and with Captain Shaw at its head it speedily became for effectiveness second to none in the world. Some idea of the magnitude of the work superintended by Captain Shaw may be gathered from the fact that there are, in the four districts into which he has divided London, 50 fire-engine stations, 109 fire escape stations, 4 floating stations, 56 telegraph lines, 104 miles of telegraph lines, 3 floating steam fire engines, 1 iron barge to carry a land steam fire engine, 3 large land steam fire engines, 26 small land steam fire engines, 12 7-inch manual fire engines, 60 6-inch manual fire engines, 36 under 6-inch manual fire engines, 17 hose carts, 125 fire escapes and long scaling ladders, and 490 firemen, including the chief officer, the 4 superintendents, and all ranks.

CAPTAIN EYRE MASSEY SHAW, C.B., CAPTAIN OF THE LONDON FIRE BRIDAGE.

Possessed of fine physique and with a cool and dauntless courage, he is ever seen, like a good general, *leading* his men as well as guiding and directing them. Indeed, this is one great secret of his success, he works *with* his men in every way, and we are not far wrong when we affirm that there is not a man in the whole Brigade who would not, to use their own words, "go through fire and water for him." There is in Captain Shaw's appearance a mingling of the soldier and the sailor, for he has been both. Two years he was a sailor and for five years a soldier, as a member of the North Cork Rifles, and two years on the staff. He was born at Monkstown Castle, County Cork, in 1830, being the third son of B. R. Shaw, Esq., of Monkstown and Bellvelly, and a cousin of Sir Robert Shaw, Bart., of Bushey Park. He was educated at Dr. Coghlan's well-known academy, Queenstown, and afterward went to Trinity College, Dublin, where he greatly distinguished himself, taking his B.A. and M.A. degrees. After retiring from the army in 1860, he became superintendent of the Borough Forces of Belfast, including Police and Fire Brigade, and on the death of Mr. Braidwood, at the great fire in Tooley Street in 1861, he was appointed to his present post; he is a Deputy-Lieutenant for Middlesex, and was in 1879 created a Companion of the Bath. As an instance of the thoroughness of the way in which Captain Shaw does his work we may mention that he has corresponded with, or personally visited, all the Fire Brigades in the world of any importance, and in 1875 drilled a force in Egypt for the Khedive, and made a report on the protection of Cairo, Alexandria, Ismailia, and Port Said; very little of which advice, however, has been acted upon. Captain Shaw has written several very useful works bearing upon the subject of fire: "Records of the Late London Fire Engine Establishment" "Fire Protection," "A Complete Manual of the Organization, Machinery, and General Working of the Fire Brigade of London," "Fires in Theaters," and "Fire Surveys," and, besides this, heaps of reports on fires in London, as he describes them himself. These same reports, though of the briefest description, show how the work of the Brigade is done.

It may not be generally known that Captain Shaw has been wounded at his work, twice very severely, and several times less so. But "small knocks," he adds, in a good-humored way, "are not counted with us."

Captain Shaw, then, is a man of whom we may well be proud, and if war has her triumphs and heroes, peace may fairly claim her share, and among the heroes of this latter class the name of Captain Eyre Massey Shaw, C.B., stands out with exceptional brightness.—*Pictorial World, London.*

PROFESSOR HUXLEY ON EDUCATION.

PROF. HUXLEY recently gave an address in connection with the distribution of prizes at the Liverpool Institute, of which we give extracts from *Nature*. He began by referring to certain propositions which he laid down in the address he gave in Liverpool fourteen years ago as to the practical value of instruction in physical science, its superiority to any other study as a mental discipline, and the certainty that in the future physical science would occupy a much larger share in the time allotted to teaching than had been the case previously. He also laid special stress upon the fact that he was no advocate of the exclusion of other forms of culture from education, but, on the contrary, insisted that it would be a serious mistake to cripple them for the sake of science. He had no sympathy, he said, with a kind of sect or horde of scientific Goths or Vandals who think that it would be proper and desirable to sweep away all other forms of culture and instruction except those in physical science. After referring to the great variety of his past experiences, his familiarity with every form of society, from the uncivilized savage from Papua and Australia, to the occasionally somewhat overcivilized members of our upper ten thousand, and to his interest in every branch of knowledge and form of art, Prof. Huxley insisted on the vast importance of science in education, when properly taught. He pointed out, however, that unless the knowledge conveyed in the teaching of science or in the teaching of history was actually realized to themselves by the learners, it would be worse than useless.

"Make it as little as you like, but unless that which is taught is based on actual observation and familiarity with facts, it is better left alone. There are a great many people who imagine that elementary teaching might be properly carried out by teachers provided with only elementary knowledge. Let me assure you that that is the profoundest mistake in the world. There is nothing so difficult to do as to write a good elementary book, and there is nobody so hard to teach properly and well as people who know nothing about a subject, and I will tell you why. If I address an audience of persons who are occupied in the same line of work as myself, I can assume that they know a vast deal, and that they can find out the blunders I make. If they do not, it is their fault and not mine; but when I appear before a body of people who know nothing about the matter, who take for gospel whatever I say, surely it becomes needful that I consider what I say, make sure that it will bear examination, and that I do not impose upon the credulity of those who have faith in me. In the second place, it involves that difficult process of knowing what you know so well that you can talk about it as you can talk about your ordinary business. A man can always talk about his own business. He can always make it plain; but if his knowledge is hearsay, he is afraid to go beyond what he has recollected, and put it before those that are ignorant in such a shape that they shall comprehend it. That is why, to be a good elementary teacher, to teach the elements of any subject, requires most careful consideration, if you are a master of the subject; and if you are not a master of it, it is needful you should familiarize yourself with so much as you are called upon to teach—soak yourself in it, so to speak—until you know it as part of your daily life and daily knowledge, and then you will be able to teach anybody. That is what I mean by practical teachers, and although the deficiency is being remedied to a large extent, I think it is one which has long existed, and which has existed from no fault of those who undertook to teach, but because until within the last score years it absolutely was not possible for any one in a great many branches of science, whatever his desire might be, to get instruction which would enable him to be a good teacher of elementary things. All that is being rapidly altered, and I hope it will soon become a thing of the past."

Then as to the important question of time, Prof. Huxley said that all he asked for was that scientific teaching should be put into what politicians and statesmen call the condition of the "most favored nation"; that is to say, that it shall have as large a share of the time given to education as any other principal subject. On the important question as to what should be regarded as "principal subjects," Prof. Huxley remarked as follows:

"I take it that the whole object of education is, in the first place, to train the faculties of the young in such a manner as to give their possessors the best chance of being happy and useful in their generation; and, in the second place, to furnish them with the most important portions of that immense capitalized experience of the human race which we call knowledge of various kinds. I am using the term knowledge in its widest possible sense, and the question is what subjects to select, by training and discipline in which the object I have just defined may be best attained. I must call your attention further to this fact, that all the subjects of our thoughts, feelings, and propositions, leaving aside the mere materials and occasions of thinking and feeling—our sensations, as all our mental furniture—may be classified under one of two heads; as either within the province of the intellect, something that can be put into proposition and affirmed or denied, or as within the province of feeling, or that which, before the name was defiled, was called the æsthetic side of our nature, and which can neither be affirmed nor denied, but only felt and known. According to the classification which I have put before you, then, the subjects of all knowledge are divisible into two groups, matters of science and matters of art; for all things with which the reasoning faculty alone is occupied come under the province of science, and, in the broadest sense, and not in the narrow and technical sense in which we are now accustomed to use the word art, all things feelable, all things which stir our emotions, come under the term of art, in the sense of subject matter of the æsthetic province. So that we are shut up to this—that the business of education is, in the first place, to provide the young with the means and the habit of observation; and, secondly, to supply the subject matters of knowledge, either in the shape of science or of art, or of both combined. Now, it is a very remarkable fact—but it is true of most things in this world—that there is hardly anything one sided or of one nature, and it is not immediately obvious what, of the things that interest us, may be regarded as pure science, and what may be regarded as pure art. It may be that there are some peculiarly constituted persons, who, before they have advanced far into the depths of geometry, find artistic beauty about it, but, taking the generality of mankind, I think it may be said that when they begin to learn mathematics their whole souls are absorbed in tracing the connection between the premises and the conclusions, and that to them geometry is pure science; so I think it may be said that mechanics and osteology are pure science. On the other hand, melody in music is pure art. You cannot reason about it; there is no proposition involved in it. So, again, in the pictorial art, an arabesque, or a 'harmony in gray,' touch none but the æsthetic faculty. But a great mathematician, and even many persons who are not great mathematicians, will tell you that they derive intense pleasure from geometrical reasonings. Everybody knows that mathematicians speak of solutions of problems as 'elegant,' and they tell you that a certain mass of mystic symbols is 'beautiful, quite lovely.' Well, you do not see it. They do see it because the intellectual process, the process of comprehending the reasons symbolized by these figures and these signs, confers upon them a sort of pleasure, such as an artist has in visual symmetry. Take a science of which I may speak with more confidence, and which is the most attractive of those I am concerned with It is what we call morphology, which consists in tracing out the unity in variety of the infinitely diversified structure of animals and plants. I cannot give you any example of a thoroughly æsthetic pleasure more intensely real than a pleasure of this kind—the pleasure which arises in one's mind when a whole mass of different structures runs into one harmony as the expression of a central law. That is where the province of art overlaps and embraces the province of intellect. And if I may venture to express an opinion on such a subject, the great majority of forms of art are not, in the sense what I just now defined them to be, pure art; but they derive much of their quality from simultaneous and even unconscious excitement of the intellect. When I was a boy I was very fond of music, and I am so now; and it so happened that I had the opportunity of hearing much good music. Among other things, I had abundant opportunities of hearing the great old master Sebastian Bach. I remember perfectly well—though I knew nothing about music then, and I may add know nothing whatever about it now—the intense satisfaction and delight which I had in listening by the hour together to Bach's fugues. It is a pleasure which remains with me, I am glad to think; but of late years I have tried to find out the why and wherefore, and it has often occurred to me that the pleasure, in musical compositions of this kind, is essentially of the same nature as that which is derived from pursuits which are commonly regarded as purely intellectual. I mean that the source of pleasure is exactly the same as in most of my problems in morphology—that you have the theme in one of the old masters' works followed out in all its endless variations, always appearing and always reminding you of unity in variety. So in painting; what is called truth to nature is the intellectual element coming in, and truth to nature depends entirely upon the intellectual culture of the person to whom art is addressed. If you are in Australia, you may get credit for being a good artist—I mean among the natives—if you can draw a kangaroo after a fashion. But among

men of higher civilization the intellectual knowledge we possess brings its criticism into our appreciation of works of art, and we are obliged to satisfy it as well as the mere sense of beauty in color and in outline. And so the higher the culture and information of those whom art addresses, the more exact and precise must be what we call its 'Truth to nature.' If we turn to literature the same thing is true, and you find works of literature which may be said to be pure art. A little song of Shakespeare or of Goethe is pure art, although its intellectual content may be nothing. A series of pictures is made to pass before your mind by the meaning of words, and the effect is a melody of ideas. Nevertheless the great mass of the literature we esteem is valued not merely because of having artistic form, but because of its intellectual content, and the value is the higher the more precise, distinct, and true is that intellectual content. And if you will let me for a moment speak of the very highest forms of literature, do we not regard them as highest simply because the more we know the truer they seem; and the more competent we are to appreciate beauty, the more beautiful they are? No man ever understands Shakespeare until he is old, though the youngest may admire him; the reason being that he satisfies the artistic instinct of the youngest and harmonizes with the ripest and richest experience of the oldest. I have said this much to draw your attention to what, to my mind, lies at the root of all this matter, and at the understanding of one another by the men of science on the one hand, and the men of literature and history and art on the other. It is not a question whether one order of study should predominate or that another should. It is a question of what topics of education you shall select which will combine all the needful elements in such due proportion as to give the greatest amount of food and support and encouragement to those faculties which enable us to appreciate truth, and to profit by those sources of innocent happiness which are open to us, and at the same time to avoid that which is bad and coarse and ugly, and to keep clear of the multitude of pitfalls and dangers which beset those who break through the natural or moral laws."

Professor Huxley then went on to point out the worthlessness of the kind of literary education that used to prevail in English schools, and gave his idea of what a literary education ought to be. If, he said, he could make a clean sweep of everything, and start afresh, he would in the first place secure the training of the young in reading and writing, and in the habit of attention and observation both to that which is told them and that which they see; and he would make it absolutely necessary for everybody, for a a longer or shorter period, to learn to draw, and there is nobody who cannot be made to draw more or less well.

"Then we come to the subject matter, whether scientific or æsthetic, of education, and I should naturally have no question at all about teaching the elements of physical science of the kind I have sketched in a practical manner; but among scientific topics, using the word 'scientific' in the broadest sense, I would also include the elements of the theory of morals and of that of political and social life, which, strangely enough, it never seems to occur to anybody to teach a child. I would have the history of our own country and of all the influences which have been brought to bear upon it, with incidental geography, not as a mere chronicle of reigns and battles, but as a chapter in the development of the race and the history of civilization. Then with respect to æsthetic knowledge and discipline, we have happily in the English language one of the most magnificent storehouses of artistic beauty and of models in literary excellence which exists in the world at the present time. I have said before, and I repeat it here, that if a man cannot get literary culture of the highest kind out of his Bible, and Chaucer, and Shakespeare, and Milton, and Hobbes, and Bishop Berkeley, to mention only a few of our illustrious writers—I say, if he cannot get it out of those writers, he cannot get it out of anything; and I would assuredly devote a very large portion of the time of every English child to the careful study of the models of English writing of such varied and wonderful kind as we possess, and what is still more important and still more neglected, the habit of using that language with precision and with force and with art. I fancy we are almost the only nation in the world who seem to think that composition comes by nature. The French attend to their own language, the Germans study theirs; but Englishmen do not seem to think it is worth their while. Nor would I fail to include in the course of study I am sketching translations of all the best works of antiquity or of the modern world. It is a very desirable thing to read Homer in Greek; but if you don't happen to know Greek, the next best thing to read is as good a translation of it as we have recently been furnished with in prose. You won't get all you would get from the original, but you may get a great deal, and to refuse to know this great deal because you cannot get all seems to be as sensible as for a hungry man to refuse bread because he cannot get partridge. Finally, I would add instruction in either music or painting, or if the child should be so unhappy, as sometimes happens, to have no faculty for either of these, and no possibility of doing anything in an artistic sense with them, then I would see what could be done with literature alone; but I would provide in the fullest sense for the development of the æsthetic side of the mind. In my judgment these are all the essentials of education for an English child." Prof. Huxley concluded by saying that if the educational time permitted, there were one or two things he should be inclined to add to these essentials (which fitted an Englishman to go anywhere or to enter on any career); among these additional subjects he mentioned Latin and German. Beyond that, let each man take up his special line.

NEW WEIGHTS AND MEASURES IN TURKEY.

By a decree of the Sultan the metric system of weights and measures came into force in Turkey on March 1, 1883, the equivalents of the old and the new weights and measures being stated as follows: The unit of length, the archine, to be of the length of the meter. The archine is divided into 10 parmaks (inches); the parmak into 10 khats (lines); and the khat into 10 noktas (points). The mill is equal to 1,000 archines, and the pharoagh is equal to 10 mills. The pharoagh is also estimated as a two hours' journey. The unit of square measure, or the new deunum, contains 100 square archines, the djerib containing 100,000 square archines. The sultchek is a new unit of capacity or cube measure, whose sides are equal to a parmak. The kilé contains 10 sultcheks, the sultcheks 10 koutons, and the kouton 10 zarfs. In weights, the new ock is divided into 100 drachmas, the drachma into 10 denks, the denk into 10 boughdais, the boughdais into 10 habbes (grains). The new batman contains 10 ocks, the kantar is divided into 10 batmans, the tckéki into 10 kantars.

THE SWISS WATCH TRADE.

A GENEVA correspondent of the *London Times* writes as follows from that city: "According to the annual report of the Swiss Handels und Industrie Verein, the Swiss watch trade during the last thirty years has undergone some notable changes. The more general use of machinery, the establishment of factories, and the introduction of improved methods of manufacture have cheapened production and led to a great extension of business. In these factories, watches, with some trifling exceptions, are made from beginning to end as they are made in the large American watch factories. It is nevertheless not the case, as is sometimes asserted, that Americans were the first to make watches by machinery. A firm at Geneva, Vacheron & Constantin, had a factory and turned out watches by machinery before a single watch was made in the United States, and the Americans procured their first watch-making machinery from Switzerland. But Geneva has lost its ancient supremacy in watch making. Fine watches (*montres soignees*) are put together and regulated here, but the greatest market in the country, probably in Europe, is Chaux-de-Fonds, in Canton Neuchatel.

The factory system is being largely adopted in the newer watch-making districts, such as the Bernese Jura, and the town of Bienne. The latter place is fast becoming a sort of horological Sheffield. Many Geneva houses have found it expedient to establish agencies there, and a trade of which Geneva had once the monopoly—the making of watch cases—has gone altogether to Bienne. The movements of complicated watches—chronographs, repeaters, and perpetual calendars, etc.—are still made exclusively in the valley of Lake Joux, and no place, in or out of Switzerland, shows any disposition to dispute the supremacy of the mountaineer of the Vaudois Jura in this, the highest branch of horologic art. The report from which I quote observes that one of the results of the extension of mechanical watch making has been to deprive Switzerland of the practical monopoly in the production of time-keepers which she once enjoyed. She has now several foreign competitors. American competitors, "albeit their pretensions are as lacking in modesty as their goods in quality," are regarded as the most formidable—in America. This competition has, however, its favorable side, for during the last two years American watch makers have procured their "movements" and their most tastefully executed cases in Switzerland. English and German competition, especially German, is mentioned with something like contempt.

Swiss watches, owing to improved methods of manufacture, are now higher in quality and lower than ever, and, say the authors of the report, the best and cheapest in the world. Many foreign watch makers resort to Switzerland for their supplies, and hundreds of watches sold abroad as "home-made," are made in this country. The calamitous crisis of 1874 and previous years is now at an end, and, thanks chiefly to the American demand, the Swiss watch trade is fairly active. England and France (notwithstanding the rivalry of Besançon) are good customers; the demand from Germany, Austria, and Russia (which take mostly watches of inferior quality) is not so good as could be wished, but the trade with Spain, Portugal, Italy, and the East shows decided signs of improvement. Prices have not, however, increased in proportion to the increased demand, and there is reason to fear that production is again outrunning consumption. Wages, too, are showing a tendency to rise; in several departments an advance has been already conceded, and altogether the position and prospects of manufacturers are much less satisfactory than might be desired.

The above item of news is going the rounds of the press, and so far as it relates to the state of the Swiss watch trade its statements may be true; but when the correspondent copies a sentence from a late Swiss report on horological matters, it at once sets afloat misrepresentations and untrue statements concerning American watches and the watch trade in America. We do not care to champion the "modesty" of our great watch companies, yet had American-made watches been excelled in all exhibits at home and abroad, we presume their makers would have been modest enough to suit a Swiss committee; but since they won the highest awards at London, Paris, Philadelphia, Sydney, etc., they have made such an exhibition of superiority that we doubt their ever being forgiven by their Swiss and French competitors. This committee who reports such a terrible lack of modesty among American watch manufacturers states that we are "now purchasing our finer movements and cases" of them. There is scarcely any truth in this statement. The "movements" imported into America without cases, which are the bulk of all our watch importations, are not fine, not averaging to cost over five dollars each. Fine watch cases, without movements, we do not import at all. In fine watches, comparatively a few complicated watches, such as independent seconds, chronographs, and repeaters, are imported in cases, and it is desirable that such watches made on the Swiss plan should be cased before they are finished, each watch having a case peculiarly its own.

America is to-day producing the finest and best watches for the money in the world, and if this "modest" committee are consoling themselves that they will always control the manufacture of complicated watches, they may find new bereavement in the fact that more than one of our companies are producing center and independent second watches, while the best chronograph we have ever seen—and we have seen the finest that have come to America—has been placed upon the market recently by an American company. This watch marks fifths of seconds, has independent fly-back, split seconds, and is just as much more accurate in its performance as it is more simple in its construction than those of foreign make. In the construction of these watches, Americans have adapted their machinery to making these complicated watches, and there is need of no prophetical power to declare that the few shops or huts in the "mountains of Jura" will not long make exorbitant prices for those who desire to buy a complicated watch, whether it be a chronograph, a repeater, or both combined in one watch. The day is not far distant when they will be made in America, on the American plan, at American prices. American jewelers and watch makers of twenty years ago will not soon forget the wrongs and extortion they suffered at the hands of foreign watch manufacturers when they had the American markets all to themselves.

England and Scotland are now having sent into their towns by the hundreds a "Boston Lever Watch" that comes from over the Alps instead of across the Atlantic. This watch is sold at prices varying from seven and a half to ten dollars, fully twenty per cent. higher than they would sell, if sold at all, in the United States. Watches of American manufacture, better in movement and case, could be furnished, with duty added, at the prices charged for this *counterfeit* if it were possible for our companies to supply home demands, and have goods for export. Unless American models and methods are followed by foreign manufacturers soon, it will not be many years before the product of our watch factories will be such that they can supply the foreign as well as the domestic demand. The demand for American watches has never declined with any people when they have become known. A prominent jeweler of Liverpool recently told a friend of *The Jewellers' Journal* that the Elgin Watch Company had gone out of business! "They used to be 'ere in London," he said, "but I never sold them." After examining a No. 50 for half an hour, and being told the company had never shut down or missed paying its hands in full on every pay day since it began business and that it was then making over six hundred watches per day, he looked in amazement, first at the watch and then at the German citizen who had told him the facts, and said: "Those Yankees beat 'ell."

THE CHRYSANTHEMUM AND ITS CULTURE.

THE chrysanthemum is, of all flowers, one of the most effective, and its many good qualities recommend it to cultivators of every grade. It is robust, hardy, easily increased by cuttings and seeds varied in form, color, and even in fragrance, and it blooms naturally at a season when other flowers are proverbially scarce. So strikingly effective are its blooms, that they are equally well suited for exhibition stands or as cut flowers for the drawing room, and so also the plant is amenable to severe and formal training into "specimen" shape; or it may be, as we think, more wisely allowed to assume its natural habit of growth, and so become especially well suited for greenhouse and conservatory, or even room and window decoration. During the past year or two especial attention has been paid to the culture and selection of the early summer blooming as also the very late blooming varieties of the Japanese and incurved types, so that now we may count on having chrysanthemums in bloom from July until nearly the end of February, a period of at least seven months. We have but few other garden flowers so valuable for all purposes, and still fewer that may fairly be called an everybody's plant. It is as well fitted for the cottage garden, for a sunny corner beside the porch, as for the marble floored conservatory. Every cottager, every artisan, may grow it to perfection with but little trouble or expense. Oh! that you men of Lancashire, born gardeners and florists by nature as you are, would but take up the chrysanthemum in the same earnest spirit as that which prompted you to take up the auricula, the onion, and leek, the big gooseberry, and the celery as objects worthy of your cultural devotion and skill! Would that "merry Sherwood" men ("Notthingham lambs" if you like) could be induced to make the chrysanthemum their winter queen, even as they have long enthroned fair Rosa as their summer one! We look to the artisans of Coventry—the city of art weaving—and to the flower loving people of Norwich; these are the men into whose hands we would fain trust our favorite. Beautiful as the chrysanthemum now is, there yet remains open a wide field for improvement. The summer blooming or early flowered section lacks size and form as yet, and vivid color and fragrance may be still further increased even among the types which now possess these attributes in the highest degree. In some cases grafting weakly rooting kinds upon robust growers as stocks may be practiced with advantage, and

The Question of Seed Saving in our own climate is as yet far from being exhausted. Under good treatment the finest of home saved seed may be produced in a properly constructed house fully exposed to spring and early summer sunshine, and heated with a flue, the latter being preferable in this case to hot water pipes. Home growers have been too lethargic in the matter of seed saving, and yet no other cultivators could possibly beat them in this field if a beginning be once made on proper and well defined lines. If we once could but induce people to raise seedlings as well as grow beautiful blooms, we should be on a fair road toward enhancing color and probably emphasizing that fragrance which a few kinds possess. We must not be too restricted in our ideas as to what are and what are not good kinds. Instead of trying to limit varieties to one or two standards of perfection, our object should rather be the extending of the boundary lines of variation. All tastes must be consulted. The florist or exhibition grower must have his incurved anemone, Japanese, and pompone varieties, but the artist also must have his bits of twisted fringe and glints of color in tassel and frill of varied kinds. The botanist, too, must have structural peculiarities and forms of floret the most varied and distinct. Even the æsthetics must have their whims gratified with single or daisy-like blooms, for it is not wise to restrict our admiration to those kinds in which reduplication of florets is the rule, and it is in the direction of single flowered kinds that we are likely to gain most in vivid coloring, beautiful alike for artistic and decorative uses. I am firmly convinced that if raisers of seedlings will but widen their sympathies, and not throw away their single flowered seedlings, as they hitherto have done, we shall soon be surprised at the immense variety of type and form and color which raisers may produce. We have hitherto worked in narrow grooves, and the immense capacity for variation, of which the chrysanthemum is possessed, has as yet been scarcely dreamed of, even by those of us who are most sanguine. As tending toward the desired increase in that direction, which in this, as in other cases, may become most charming, I most earnestly counsel all growers of the chrysanthemum to raise a few seedlings every year, even if it be from imported seeds. The raising of seedlings is said to be the "poetry of gardening," and if this be so, then it was never more true than in the case of the popular flower now under notice. But the heyday of all that beauty and variety, of which the chrysanthemum is by nature and art capable, will, I feel persuaded, only come to us as the result of patience and labor in the growth and culture of the produce of home saved seeds—the results of our own ideas and desires rather than in the growth of plants from seeds saved abroad, as is now supposed to be best. Another important point as regards seed saving, and one on which too much stress cannot well be laid, is that cross fertilization has been but rarely resorted to, too much reliance having hitherto been placed upon inherent tendency toward natural variation.

History of the Chrysanthemum.—Of all flowers that which has been said to represent "cheerfulness under adversity"—the chrysanthemum or "Golden Flower" of the Greek—may fairly be called the "Queen of Autumn," six varieties of which were described by Breynius as being cultivated in Holland two centuries ago. Originally introduced to England from the Celestial Empire in 1764, it seems first to have been cultivated by that celebrated gardener, Miller, of Chelsea, but was soon afterward lost by some unfortunate accident. Again introduced, this time by way of Marseilles in

1789, it reached London in 1795, and in "Curtis's Botanical Magazine" for 1796 we find a colored figure of chrysanthemum sinense (there described under the name of C. indicum),* the result of the second advent. Phillips, in his "Flora Historica," published in 1824, tells us that the new plant was sold at a high price soon after its introduction, but that it was not until the beginning of the nineteenth century that it attracted attention as a florist's flower. "Then," says he, "like the roses of China, chrysanthemums soon escaped from the conservatories of the curious, and as rapidly spread themselves over every part of the island, filling the windows of the cottagers and the parterres of the opulent with their autumnal beauties, that now vie with the China aster in variety of color glory."

Among other peculiar modes of culture resorted to by Chinese gardeners in chrysanthemum culture is the engrafting of cuttings on to a strong growing species of artemisia (A. indica) as a stock. The idea of grafting is suggestive, as some of the more delicate rooting kinds might be best grown by being grafted or inarched upon rooted cuttings or sucker stocks of a robust, strong rooting character. Some may think this idea impracticable, but I know that Chinese gardeners rarely take any special trouble in plant culture without a sound reason for so doing, and cultivators at home will, I hope, leave "no stone unturned" in this respect. One reason why grafting might be useful is that by its means new sports might in all probability be obtained. Fortune tells us of the beauty of the chrysanthemum in Oriental gardens, and how banks of the gorgeous blooms are illuminated at night with lanterns, and how that even gigantic effigies are made up entirely of their lovely flowers.

Even when the Chinese emigrate to other lands, this their favorite flower is carried with them and affectionately cultivated. Here is an instance of this practice. I once went to see the late Consul Whampoa's garden at Singapore,† the entrance to which is a long bower of the most superb tropical flowers, waving crimson stemmed palms, and climbing plants of great beauty. Here the "Sacred Tree of Heaven," Amherstia nobilis, bends under the weight of umbrageous leafage and pendent wreaths of the most gorgeous crimson and golden blossoms. Every pool and stream, of which there are many in this garden, are filled with the rarest of water lilies and lotus flowers. After our host had shown us all this—all the tropical treasures of Kew or Glasnevin in the open air and sunshine—he led us triumphantly to a little sheltered spot and showed us, with pleasure beaming from every wrinkle of his smoothly shaven face, hot orchids of curious structure, nor water lily of a loveliness divine—neither palm nor fern of filmy beauty—nothing more nor less than a bed of chrysanthemums, the one flower of his heart, reminding him of home and country. That the artists and poets of China and Japan have lavished much of their finest and best thought and labor in representing this flower in all pleasant aspects to the senses is now a matter of history, attested by ceramic wares and textile fabrics of many kinds. The Japanese more especially possess voluminous illustrated works in which the chrysanthemum, in all its phases of race and color, is ably portrayed. The Rev. G. Henslow has well described how

The Transformations in the Corolla are brought about—the two principles of hypertrophy and atrophy both conspiring to effect the remarkable changes. Thus, while the corolla enlarges, to change from a five-toothed minute disk floret into a broad, flat petaled ray floret, two petals are gradually dwarfed and finally disappear; while a corresponding atrophy takes place in the essential organs, for the stamens are totally arrested and the pistil changes its form, the style arms becoming much reduced in size. The tubular condition of the corolla may remain, while the tube itself elongates without any or much splitting—hence the quilled and tasseled forms are arrived at, both representing a more or less arrested stage in the process of change into ray florets. The ligulate petal may be broad—which gives rise to the incurved and recurved ball-like forms; or it may be greatly elongated and narrow—whence the Japanese linear-petaled forms; or it may be expanded at the mouth, and the teeth multiplied—which gives the trumpet-like, so-called, Dragon chrysanthemum. Lastly, if the disk florets enlarge, but remain more or less tubular while the ray retains its distinctive character, the anemone form is secured.

The First Chrysanthemum that ever flowered in England flowered in Colville's nursery, in the King's Road, Chelsea, in 1795, the plant having been obtained originally from M. Cels, the celebrated nurseryman, of Paris. At this time, and for some little time afterward, botanists had a contest as to its botanical position; some of them contended that it was one of the camomiles (Anthemis), while others declared that it was unmistakably a pyrethrum or feverfew, but at last it was decided that it should be called chrysanthemum, from chrysos, gold or golden, and anthos, a flower. Sabine, who was secretary to the Horticultural Society at the beginning of the present century, says, however, that chrysanthemums had been grown and flowered in Holland nearly as far back as the year 1688; but, singular to say, in 1821 no gardener in Holland knew anything of them. In 1808 their cultivation had increased to some nine or ten varieties, and it went on increasing, many varieties being collected for the Royal Horticultural Society in China and Bengal, in 1821, by Mr. Parks. At the end of 1825 the number of varieties seems to have been increased to 48, and in 1826 Sabine writes most cheerily concerning their rapid progress and of an astoundingly large exhibition of them being held in the society's garden at Chiswick, in which were shown over 700 plants of them in pots.

The First Sport from the original variety was noted in 1822, in which year Mr. Colville, of Chelsea, sent to Chiswick a pale pink variety, which had sprung from a sort called Changeable Buff. It is curious to note the names given to some of the varieties about this time. Let one or two be given for curiosity's sake: Early Blush, Park's Small Yellow, Blush Ranunculus, Curled Blush, Tasseled Yellow, Tasseled Lilac, Two Colored Red, Double White Indian, Yellow Indian, Waratah, Quilled Pink, Pale Purple. These names, which in a sense give the characteristics of some of them, seem to indicate that in what are now called the show varieties, which are largely of the strain of Chrysanthemum sinense, there were the same special singularities as are to be seen now, only that now these idiosyncrasies are positively classified. We often hear of incurved flowers, and recurved or reflexed flowers, of quilled flowers, of tasseled flowers, and of anemone flowers, besides the Pompones and the Japanese. Well, the incurved flowers are those whose flat florets curve or bend in toward the center of the bloom; the recurved or reflexed bend backward from the center (the recurved moderately, the reflexed more so); the quilled have the edges of their florets involute and coherent, so that they look like small pipes or tubes; the tasseled are the loose, long, and flat petaled flowers not coming under the other definitions; and the anemone flowers are those kinds having a cushion-like center of tubular disk florets, surrounded by a ray of flat or star-shaped florets of the usual kind.

Origin of the Pompones.—In 1845 the late Mr. Robert Fortune who was sent to China, in 1842 by the Royal Horticultural Society, brought home with him from Chusan (an island on the east coast of China) a semi-double reddish or light brown small Chrysanthemum, which was called the Chusan Daisy. The Horticultural Society propagated it and sent it out among its members. From some of these members it was sent to M. Lebois, a perfect enthusiast in chrysanthemum growing, in Paris. He seeded it, the autumns of France being more favorable to that operation than the cold foggy ones of England, and from this seed he raised a great many good varieties which got into the hands of Mr. Salter, late of the Versailles Nurseries, Hammersmith, who in his day did more to popularize chrysanthemums in England than any other man. Some of the best varieties, not only of Pompones, but of the other larger varieties, were introduced by him. He had a perfect knowledge of what was being done by the French growers, and generally secured their best seedlings. This is the generally received history of the Pompone varieties of chrysanthemum, though we may infer from some of the names given to them as far back as 1821 and 1825, Park's Small Yellow, Blush Ranunculus, etc., for instance, that there were small varieties grown then; indeed, in the Horticultural Society's Transactions for February, 1821, there are colored plates of small, many-petaled varieties, though they were not called Pompones until the French got hold of them in 1845–46. In 1846 a new era commenced in the history of the chrysanthemum, for at that time Mr. Fortune brought from China two small-flowering varieties, the "Chusan Daisy," just named, and "Chinese Minimum." Although Mr. Fortune admired them in Chusan, they were considered too small and insignificant for English taste. The French opinion of them was far different, for immediately upon their introduction, in 1847, into the already well-known collection at Versailles, the little "Chusan Daisy" became a favorite. From these two varieties have sprung all the Pompones now in cultivation. The French growers gave them this name, Pompone, from the resemblance of the flower to the tuft or pompon on the soldiers' caps.

Japanese Kinds.—These were brought over by Mr. Fortune on a second visit to Japan about the year 1859 or 1860. The precise date is uncertain, but at least one variety was figured in the *Botanical Magazine* as somewhat of a novelty in 1863, so it must be about the time mentioned that they were introduced. The French and Guernsey growers soon got hold of them and have improved them immensely. They are with some growers greater favorites than either of the other two older varieties. In 1862 Mr. Salter introduced several Japanese varieties, some of which were spotted and striped; others were of fantastic forms called dragons, and one, lacinatum, was a beautifully fringed white flower, and invaluable for bouquets, having the appearance of a Japanese pink ratherthan of a chrysanthemum. One had petals like long thick hairs of a red color, but tipped with yellow, looking like the fringe of a shawl or curtain; another had broad white petals striped with red, like a carnation or camelia, while others were remarkable for their great size and brilliant coloring.

Show Chrysanthemums.—In 1850 we find the chrysanthemum taking rank as a winter exhibition plant at the meetings of the Caledonian Horticultural Society, which at that time held its shows in what is now the Royal Botanical Gardens, Inverleith. Here we are told that "Chrysanthemums were the principal flowers exhibited. The prizes for single clusters of twelve varieties were awarded to Mr. Young, gardener to Mrs. H. N. Ferguson, of Archerfield, who had Minerva, Duc de Nemours, General Morceau, Salter's Annie, Queen of Yellows, Princess Maria, Clustered Yellow, Queen Victoria, Compte de Rantzau, Bicolor, Queen and Marquis; and to Mr. Mitchell, for Temple of Solomon, Princess Marie, Antoinette, Celestial, Queen, Salter's Annie, and others. For the most dwarf and finest flowered plants, the prize was awarded to Mr. A. Sleigh, gardener to the Lord Advocate, Lauriston Castle, the kinds being Bicolor, Queen, Mirabile, and David." I give the extract as it stands from the *Gardener's Magazine of Botany* (1850), as not only are the names of the varieties interesting, but also the custom which then was followed of showing the flowers in single clusters (*i. e.*, all the blossoms as produced on one stem) instead of single blossoms as now

British Kinds.—So popular are the chrysanthemums of China and Japan, that one almost forgets that there are other species. "Charity begins at home," and so we must not lose sight of the two chrysanthemums of our own country, commonly known as the ox-eye daisy (C. lucanthemum) and the corn marigold (C. segetum). Who can say what the ox-eye of our meadows would produce in a few years if it were cultivated from seed with a little of that faith and persistence so characteristic of the Chinese gardeners? Even our golden corn marigold has been neglected, although in its native state it is one of the brightest and best of all annual composites. Its Algerian relative (C. coronarium) has met a better fate, and we have now many varieties both single and double in our gardens. The same may be said of C. carinatum, which is likewise a very beautiful annual, although the Chinese use it as a pot-herb, just as their Japanese cousins eat up the succulent bulbs of Lilium auratum, thinking more of their use than of their beauty. C. arcticum, C. speciosum, C. lacustre, and C. stratum are all well known hardy species, the last named being a more noble and stately edition of the ox-eye of our meadows. Of all the late blooming hardy herbaceous kinds, however, C. (pyrethrum) serotinum, also known as C. uliginosum, is one of the most effective, producing its green-eyed stars in October or later, and continuing in beauty until cut down by the early frosts of November. The shrubby C. frutescens, better known as the Marguerite or the Paris Daisy, has of late years become almost as great a favorite in English gardens as it has long been in those of the Continent. There are several varieties, C. tanacetifolium being one of the best of the white rayed kinds, and C. etoile d'or, a seedling from C. Comte de Chambord, is the best of the sulphur-rayed varieties. All are beautiful planted out in the open borders in May, or as grown in pots in a sunny greenhouse they bloom throughout the winter months, when their flowers are especially valuable. C. coronarium, C. carinatum, C. burridgeanum, and other annual species are easily raised from seeds sown in spring-like mignonnette stocks, or other hardy annuals. The herbaceous kinds, C. lacustre (syn., C. maximum), C. uliginosum, and others, are best increased by division in the spring or early summer months. C. frutescens and other allied sub-shrubby kinds are easily propagated from cuttings.—*F. W. B., in The Garden.*

* The figure in the "Botanical Magazine," vol. x., t. 327, represents a double bloom, with quilled florets of a maroon purple color inside, and of a silvery or rose purple outside. Dr. Sharpe, a modern reflexed variety, very closely resembles this figure in all ways. It is in reality the Chinese chrysanthemum (C. sinense), and not C. indicum, which is the type of the pompone or small flowered rose.

† Mr. Whampoa was a Chinese trader, who early in life left China and settled in Singapore. He rose to affluence, and was a C. M. G.

MANURING POTATOES WITH POTASSIUM NITRATE.

By EDLER.

IN previous communications from the agricultural station at Göttingen, it was shown that the use of potassium nitrate raised the yield above that produced by sodium nitrate, that both manures produce larger tubers, and that with potash manures the disease was less than with the sodium compound. Moreover it was shown that the percentage of starch was lowered by sodium nitrate, but not by the potassium salts. The experiments have been continued during the two succeeding seasons (1880 and 1881), but owing to the bad season of 1880 the results obtained were inconclusive; the season of 1881, however, was more favorable, and the results obtained corroborate those obtained in 1879. Potash saltpeter distinctly increased the total yield, as also the yield of large tubers, and it did not lower the percentage of starch in the large tubers, whereas sodium nitrate did; the percentage of starch in the medium and small-sized tubers grown on the unmanured plots was, however, higher than that contained in the corresponding sized tubers, but which had been manured. The application of potassium nitrate was also a financial success.—*Bied. Centr.*

A CATALOGUE containing brief notices of many important scientific papers heretofore published in the SUPPLEMENT, may be had gratis at this office.

THE
Scientific American Supplement.
PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50, stitched in paper, or $3.50, bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
261 Broadway, New York, N. Y.

TABLE OF CONTENTS.

PAGE

I. ENGINEERING AND MECHANICS.—The Indus Railway Bridge.—3 illustrations 6071
Vibrations of Bridges 6071
Foot Bridge at La Villette.—Several figures 6072
New York Terminus, N. Y., W. S. & B. R.—3 figures 6073
Grain Elevators 6073
Siebel's Coke Furnace.—3 figures 6074
A New Ore Separator.—5 figures 6075
Harrow for Breaking up the Surface of Macadamized Roads.—5 figures 6075
Megy's Compressed Air Whim.—Several figures 6076

II. ELECTRICITY.—An Electric Alarm.—1 figure 6079
Desruelle's Galvanometric Trial Bell.—1 figure 6079
Hopkinson's Current Meter.—2 figures 6079
The Electrolytic Balance of Chemical Corrosion 6079
A New Experiment in Electrolysis.—2 figures 6080
Nitric and Chromic Acid Batteries. By JOHN T. SPRAGUE 6080

III. CHEMISTRY AND METALLURGY.—Ice Under Low Pressure.—1 figure 6081
Apparatus for Boiling Gold Assays. By W. F. LOWE.—3 figures.. 6081
Conversion of Alizarine Blue into a Soluble State 6081

IV. MEDICINE AND HYGIENE.—Alcohol in Health. By C. BARLOW, M.D. 6082
Malaria. By Dr. JAMES H. SALISBURY.—IV. Descriptions of several cases.—Therapeutical remarks.—Plants in the urine of ague.—Numerous figures 6082
Cephalic Auscultation in Mental Disease 6083

V. TECHNOLOGY.—Thorough Washing and Effectual Fixation of Gelatine Negatives 6073
The Swiss Watch Trade 6085

VI. ARCHITECTURE.—The Palazzo Vendramin-Calergi, Venice 6077
Color in Architecture. By GEO. AITCHISON.—Relation of color to man.—Color on the outside of buildings.—Origin of fine color.—Various specimens of polychromy.—Difficulties to be overcome in England 6077

VII. AGRICULTURE AND HORTICULTURE.—The Chrysanthemum and its Culture 6085
Manuring Potatoes with Potassium Nitrate. By EDLER 6086

VIII. BIOGRAPHY.—Captain Eyre Massey Shaw, C.B.—With portrait 6084

IX. MISCELLANEOUS.—Professor Huxley on Education 6084
New Weights and Measures in Turkey 6085

PATENTS.

In connection with the **Scientific American,** Messrs MUNN & Co. are Solicitors of American and Foreign Patents, have had 38 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the **Scientific American** of all Inventions patented through this Agency, with the name and residence of the Patentee. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction often easily effected.

Any person who has made a new discovery or invention can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & Co.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs, and how procured, with hints for procuring advances on inventions. Address

MUNN & CO., 261 Broadway, New York.
Branch Office, cor. F and 7th Sts., Washington, D. C.